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# 避險基金的變革、存活及篩選之研究

# Evolutionary Changes, Survival and Selection of Hedge Funds

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# 中文摘要

實務上常以夏普比率評估基金的績效表現，但該統計量的精確度與財務報酬率的統計性質有關，不正確的統計量可能導致錯誤的推論與決策。當投資人欲以夏普比率比較投資組合與標的市場組合績效時，必須確認標的市場夏普比率的統計性質，因此，依據標的市場報酬率的特質，推導其漸近分配則有其必要性。本論文共分三部分，第一篇研究為 Ho (2006)的延伸，假設標的市場報酬率遵循廣義隨機波動率模型(generalized stochastic volatility model)，本研究証明以 $\sqrt{n}$ 和非 $\sqrt{n}$ 收斂速度收斂至常態極限分配都是可能成立，該收斂速度則由報酬率的波動性之參數所決定。

第二篇研究主要在從投資者結構、績效、風險偏好及產業競爭程度的觀點，探討過去十年(1994-2004)避險基金產業的發展與變革。本研究發現投資者結構的改變是引導該產業各階段的主流投資型態及風險偏好轉趨保守的因子。各種策略基金的產業環境，會因投資者偏好改變造成不同投資型態基金間的競爭與消長，進而影響其生存空間。再者，投資者因避險基金產業的蓬勃發展，有更多投資標的可供選擇，相對在績效表現與風險的要求上，遠比產業初期嚴苛，且大量資金的流入及新設基金的成立，都促使避險基金產業環境更趨競爭。因此，新基金必須具備快速適應環境，滿足投資者要求的能力，才不致於被市場淘汰。此外，整體避險基金產業對風險的控制也較初期重視，其在股市下跌時的連動性，隨時間呈逐步降低的趨勢。

第三篇研究主要從適者生存的角度，分析經歷產業競爭、金融市場衝擊及投資者考驗而存活的成功基金群，與其他失敗或小規模基金群行為及特質的差異，藉以發現影響避險基金存活的關鍵因素。考量資料具右設限存活的特質(right censoring for survival data)，我們採用存活模型- Kaplan-Meier model, Cox proportional hazard model 探討上述關鍵因素對避險基金存活函數的影響。利用驗證後的攸關變數，建構一綜合評比的指標進行基金的篩選，並與夏普比率的篩選績效及折損率予以比較。本研究發現影響基金存活的因素包含絕對及相對績效、報酬波動率、管理資產規模、現金流量、產業被偏好程度、恢復損失能力、槓桿、高水位機制(high water mark)、提供審計財報、閉鎖時間及管理費率，但各因素對趨勢交易策略基金(directional fund)與非趨勢交易策略基金的影響程度有所不同。利用攸關資訊所建構的綜合評比指標的確能降低被挑選基金的折損率，尤其在小型基金上的效果最為顯著。其中夏普比率較適合挑選風險屬性較高的投資標的，而恢復損失比率則適合風險屬性較低的標的。

## Abstract

Sharpe ratio is a simple instrument of evaluation for funds in practice, but the accuracy of its estimator depends on the statistical properties of financial returns, thus measurement inaccuracy for the Sharpe ratio can lead to make wrong inference and decision. It is a constant task for both researchers and practitioners to use Sharpe ratio to evaluate whether a portfolio performs better than a certain benchmark index. In order to achieve this based on sound and statistical justification, it is necessary to derive the asymptotic distribution of the Sharpe ratio statistics of the benchmark of interest. Essay 1 of this study aims to extend the work of Ho (2006) by assuming that the return series follows a generalized stochastic volatility model in which the volatility component is formed by a general functional of a linear process. The study shows that both the $\sqrt{n}$ and non-$\sqrt{n}$ asymptotic normality are possible and the normalization constants are determined by the decay rate of the coefficients of the linear process that governs the volatility behavior of the returns.

Essay 2 of this study provides some evidences about the development in the hedge fund industry over the past decade, focusing on the change in the composition of investors, preference for risk and reward, and the degree of competition. The change of hedge fund is closely related to the current industrial environment and its evolution, our findings include: (1).The change in the structure of the investors drives the result of the fact that the risk preference of the industry tends to be more conservative and affects the mainstream style of strategy during each phase in industrial development. (2).The dynamic competition effect for hedge funds across each strategy affect the fund survival and main strategy varied over competition and market condition. (3).The profit-making space of hedge funds is being gradually compressed due to more intense competition, besides; investors would have the benefit of industrial contest, which have wider and more flexible choice of target investments. Therefore, investors are more rigorous for required returns and less patient to undertake a loss than before. (4).Young hedge funds face harder survival environment than before and have great difficulty to survive during elimination. (5).The overall hedge funds abandoned upside gains in the terminal bull market to reduce the reversal loss, and raised a tendency towards risk control.

Essay 3 of this study first investigates the key to the survival of the fittest by way of analyzing the difference between groups of the successful funds and other live or defunct funds. Next, in consideration of the right censoring for survival data, we use the survival models such as the Kaplan-Meier model, Cox proportional hazard model to confirm whether these factors are good predictor variables related to hedge funds' survival and estimate the survival function and time of the hedge fund. Lastly, we construct a composite filter, which make use of the relevant covariates of hazard rate, to select funds and compare the out-of-sample performance and attrition rate with the Sharpe ratio. The findings include: (1).The poor absolute, relative performance and high volatility increase the risk of failure, however, the no effect of the standard deviation of relative performance. (2).Different initial sizes lead to different investment philosophies as young age. The successful funds with an initial small size will dynamically adjust their risk/reward relationship during the lifecycle phase. (3).Directional funds are more sensitive to size than non-directional funds. The stability of the flows is the key to survival for small funds and change of favorite by investors is one factor which leads large funds to close. (4).The recovering ability of maximum loss during the tolerant period given by investors becomes a necessary condition of survival. (5).The characteristics of high water mark and providing audited reports are important factors of hedge funds' survival. The funds that do not pay attention investor's right and have the potential agency conflicts will be eliminated from competition. (6).The composite filter indeed provides the function of decreasing the attrition rate, especially, the effect for small fund selection is significant (7).Using the recovery rate to screen non-directional targets performs well and the Sharpe ratio is properly to select more volatile large targets.

Contents

# A Note on the Sharpe ratio for a class of generalized stochastic volatility processes

**Abstract** The Sharpe ratio, which is defined as the ratio of the excess expected return of an investment to its standard deviation, is one of the most commonly used risk-adjusted measure for the returns of an asset or investment. It is a constant task for both researchers and practitioners to use Sharpe ratio to evaluate whether a portfolio performs better than a certain benchmark index. In order to achieve this based on sound and statistical justification, it is necessary to derive the asymptotic distribution of the Sharpe ratio statistics of the benchmark of interest. Considering the stochastic volatility model for returns, Ho (2006) showed that in spite of the fact that the returns from a stationary sequence of martingale differences, the Sharpe ratio statistics may converge to a normal distribution with a rate slower than $\sqrt{n}$ when the latent volatility component exhibits long memory. This note aims to extend the work of Ho (2006) by assuming that the return series follows a generalized stochastic volatility model in which the volatility component is formed by a general functional of a linear process. We show that both the $\sqrt{n}$ and non-$\sqrt{n}$ asymptotic normality are possible and the normalization constants are determined by the decay rate of the coefficients of the linear process that governs the volatility behavior of the returns.

## 1. Introduction

In a mean-variance framework the Sharpe ratio, which is defined as the ratio of the excess expected return of an investment to its standard deviation, has become one of the most common risk-adjusted measure of performance used by both researchers and practitioners. The idea of the ratio is to measure how much more returns one expects to receive for each additional unit of volatility (standard deviation) of holding a risky asset over the risk-free interest rate. The two core quantities, the expected return of a risky asset and its standard deviation, from which the ratio is built, are almost always calculated from an available finite sample of returns of the underlying asset. In other words, the Sharpe ratio used in practice is in fact only an estimate of the true value, which is inevitably subject to measurement inaccuracy caused by sampling errors and has to be taken into account when any inference or conclusion is made by using the ratio. While the study of Sharpe ratio in the literature is quite extensive, it mainly focuses on the topics concerning asset pricing and its related financial implications. Relatively less thorough attention has been paid to the statistical properties of the estimation of the ratio. Miller and Gehr (1978) derived the exact bias of Sharpe ratio where returns are iid and normally distributed. Jobson and Korkie (1981) showed the asymptotic distribution of the ratio by assuming iid and normality. Lo (2002) employed GMM approach to derive the ratio's estimation errors for returns, which are iid or stationary with serial correlations, and pointed out that to make inference on the accuracy of the estimation, the serial correlation among the returns plays an important role. Mertens (2002) filled a gap in Lo's (2002) derivation for the iid case, which is valid only under normality. Mertens pointed out that the asymptotic variance of Sharpe ratio should in general include the kurtosis and skewness of returns instead of just variance and its square as presented in Lo (2002). Christie (2005) used the GMM approach to obtain the asymptotic distribution result under the stationarity and ergodicity condition in which time-varying conditional volatility, serial correlation and other non-iid returns are allowed. Knight and Satchell (2005) examined the exact properties of Sharpe ratio statistics when prices follow a log-normal process. Bao and Ullah (2006) provided the analytical second-order bias and variance for the estimates of Sharpe ratio estimator under non-iid condition and concluded that the bias and variance of estimation depend on the covariance structure of the data generating process.

The studies mentioned above are all carried out under the assumption that the Sharpe ratio statistics obey the traditional $\sqrt{n}$ central limit theorem in which the estimation errors of expected return and the standard deviation are equally important. Contrary to these previous studies, Ho (2006) demonstrated that in spite of the fact that the returns form a stationary sequence of martingale differences, the Sharpe ratio statistics may under certain circumstances converge to a normal distribution with a rate slower than $\sqrt{n}$. Moreover, the convergence rate is determined by that of the estimated standard deviation, and the estimation errors of the expected return turn out making no contribution to the limiting distribution. The return sequence considered in Ho (2006) follows the so-called stochastic volatility model in which the latent volatility sequence is the exponential of a linear process. As shown in (2.3) of Ho (2006) that the aforementioned non-standard asymptotic normality takes place when the linear process, upon which the volatility is based, exhibits persistent autocorrelation or long memory.

For the last two decade or so evidence has been reported that strong serial correlation exists in some nonlinear transformation of many financial returns, such as square, logarithm of square, and absolute value, whereas the return series itself behaves almost like white noise (see, e.g., Taylor (1986)). This stylized fact has a profound implication. The traditional mixing-type conditions of various types (Bradley (1986)), which had been widely used to specify the weak-dependence or short-

memory properties of stationary processes, are found inadequate to model the dependence structure of the returns. The ARCH model proposed by Engle (1982) and its various extensions such as GRACH, EGRACH (Nelson, (1991)) have been proved very successful to model returns. Recently, some other models are seen to provide better fitting than ARCH family for empirical data. Lobato and Savin (1998) examined the S&P 500 index series for the period of July 1962 to December 1994 and reported that the squared daily returns (and absolute-value returns) exhibit the genuine long-memory effect which ARCH process cannot produce (see also Ding et al. (1993)). This finding naturally gives rise to modeling financial returns with the long-memory stochastic volatility (LMSV) model, and was further supported by Breidt et al. (1998) that the LMSV model may capture the correlation structure of financial returns better than some popular models such as IGARCH (1,1) and GARCH(1,1).

Using the Sharpe ratio to compare the performance between a portfolio and a benchmark index is perhaps one of the most important tasks that both researchers and practitioners need to deal with constantly. In order to carry it out with statistically sound justification, it is necessary first of all to derive the asymptotic distribution of the Sharpe ratio statistics of the benchmark of interest. In the light of the work by Lobato and Savin (1998) and Breidt et al. (1998), a sensible model for returns should include the specification that incorporates the characteristic feature of long-memory volatility. This note aims to extend the work of Ho (2006) by considering a generalized stochastic volatility model in which the volatility is in the form of a general functional of a linear process. Similar to the treatment in Ho (2006), the linear process which governs the dependence structure of the volatility is allowed to be short- or long-memory.

Throughout this study the returns are modeled as follows:

$$r_t = \mu + v_t \varepsilon_t, \quad v_t = f^{1/2}(X_t). \tag{1.1}$$

Here $\{\varepsilon_t\}$ is a mean-zero-and-unit-variance iid sequence; $f$ is a positive function satisfying certain regularity conditions to be specified later and $\{X_t\}$ is a linear process given by

$$X_t = \mu_1 + \sum_{i=1}^{\infty} a_i \eta_{t-i} \text{ with } \{\eta_i\} \text{ independent of } \{\varepsilon_i\}, \tag{1.2}$$

where the $\{\eta_t\}$ is an iid sequence (Gaussian or non-Gausian) and has zero mean and finite variance. Throughout this note we assume that the innovation coefficients, $a_i$'s, are in the form of

$$a_i \sim D \cdot i^{-\beta}, \quad \beta > 1/2, \tag{1.3}$$

for some positive constant $D$. $X_t$ is usually called long-memory when $1/2 < \beta < 1$ and short- memory if $\beta > 1$.

**Remark 1.** If $f(x) = e^x$ and $a_i$ decays exponentially fast, then $\{r_t\}$ is the usual stochastic volatility model (Taylor (1986) and Harvey et al. (1994)).

In the next section some preliminaries are introduced in order to formulate a regularity condition for the function $f$ that will be used for the rest of this note. In Section 3 our two main results, Theorems 1 and 2, which deal with the short- and long-memory case respectively, are stated and proved.

## 2. Preliminaries

For a return sequence $\{r_t\}$ as defined in (1.1) denote its Sharpe ratio by

$$SR = \frac{\mu - r_f}{\sigma}, \tag{2.1}$$

where $r_f > 0$ is the risk-free interest rate and $\sigma = \sqrt{\text{var}(r_t)} = \sqrt{Ef(X_1)}$ is the standard deviation of the returns $\{r_t\}$. Because for almost all portfolios in reality, the true values of the two parameters, $\mu$ and $\sigma$, are hardly known and need to be estimated. The most natural and common statistics for $\mu$ and $\sigma$ and for SR are

$$\hat{\mu} = n^{-1}\sum_{t=1}^{n} r_t, \quad \hat{\sigma}^2 = \sum_{t=1}^{n}(r_t - \hat{\mu})^2/n, \quad \widehat{SR} = \frac{\hat{\mu} - r_f}{\hat{\sigma}}$$

The purpose of this note is to derive the limiting distribution of normalized $\widehat{SR} - SR$. An important feature of our results is that while the returns form a sequence of martingale differences and the limiting distribution is normal, the convergence rate turns out depending on whether the latent volatility sequence $\{X_t\}$ is short-memory or long-memory. In the next section we deal with these two case separately. We first define a technical condition that will be used throughout the paper. For $m \geq 1$, define

$$X_{t,m} = \mu_1 + \sum_{i=1}^{m} a_i \eta_{t-i}.$$

Let $F$ and $F_m$ be the distribution functions of $X_1$ and $X_{1,m}$, respectively. Define

$$f_j(x) = \int f(x+y)dF_j(y), \quad f_\infty(x) = \int f(x+y)dF(y). \tag{2.2}$$

If the $t$-th derivative $f_j^{(t)}$ of $f_j$ exists, define

$$f_{j,\lambda}^{(t)}(x) = \sup_{|y|\leq\lambda} |f_j^{(t)}(x+y)|, \quad \lambda \geq 0.$$

Let $t$ be nonnegative integers and $\lambda$ a nonnegative real number. We say that the condition $C(t,\lambda)$ holds, if

1. $f_1^{(t)}(x)$ exists for all $x$ and $f_1^{(t)}$ is continuous.
2. For all real $x$,

$$\sup_{I\subset\{1,2,\ldots\}} E\Big[f_{1,\lambda}^{(t)}(x + \sum_{i\in I} a_i\eta_i)\Big]^4 < \infty$$

where the sup is taken over all subsets $I$ of $\{1, 2, \ldots\}$.

**Remark 2.** Clearly condition $C(t,\lambda)$ is satisfied by polynomials $f$ if $\eta_1$ has finite moments of sufficiently high orders. The key feature of condition $C(t,\lambda)$ is that it holds without $f$ being smooth at all. It is not difficult to see that for non-smooth functions like absolute-value functions and indicator functions, $C(t,\lambda)$ follows provided that $F$ has smooth density function. In addition, if the tails of the density function of $F$ is thin enough (like Gaussian), then $C(t,\lambda)$ is implied by the function $f(x) = e^x$ which is as required by the stochastic volatility model.

## 3. Main results

### 3.1 Short-memory volatility

In order to prove the $\sqrt{n}$ central limit theorem the following assumptions are needed.

**(A1)** $E\eta_1^4 + Ef^2(X_1) < \infty$. $f$ satisfies condition $C(t,\lambda)$ for some $\lambda \geq 0$ and for $t = 0, 1$.

**(A2)** $E(f(X_1) - f(X_{1,m}))^2 = o(1)$ as $m \to \infty$.

**(A3)** $\sum_{i=0}^{\infty} |a_i| < \infty$.

**(A4)** $E\varepsilon_1^3 = 0$.

THEOREM 1. *Under assumptions* **(A1), (A2), (A3)** *and* **(A4)**,

$$\sqrt{n}(\widehat{SR} - SR) \to N(0, \delta^2) \tag{3.1}$$

*for some* $\delta \geq 0$. *If conditions* **(A2)** *and* **(A3)** *are strengthened to*

$$E(f(X_1) - f(X_{1,m}))^2 \leq C \cdot E(X_1 - X_{1,m})^2 \tag{3.2}$$

*for a constant independent of* $m$ *and*

$$|a_i| = O(i^{-\beta}) \quad \textit{with} \quad \beta > 3/2, \tag{3.3}$$

*respectively, then the limiting variance* $\delta^2$ *can be explicitly written as*

$$\begin{aligned} \delta^2 &= \frac{Ef(X_1)}{\sigma^2} + \frac{(\mu - r_f)}{2\sigma^{3/2}} \Big\{ [Ef^2(X_1)][E(\varepsilon_1^2 - 1)^2] \\ &+ [E(f(X_1) - \sigma^2)^2 + 2\Sigma_{i=1}^{\infty} E(f(X_1) - \sigma^2)(f(X_{1+i}) - \sigma^2)] \Big\} \end{aligned} \tag{3.4}$$

**Remark 3.** The main worth of Theorem 1 lies in that it does not rely on the conventional mixing-type conditions, which is in general difficult to verify, and only assumes instead the summability of the innovation coefficients. Note that the mixing-type conditions are not guaranteed to hold for the linear process $X_t$ even when $\beta > 1$ (see Bradley (1986), Pham and Tran (1985)).

**Examples.** Assume the distribution of the innovation $\eta_t$ of the latent volatility process defined in (1.2) is standard normal with its probability density function denoted by $\phi(\cdot)$. We give two examples of the function $f$ which satisfy conditions $C(t, \lambda)$ and (3.2). (1) $f^{1/2}(x) = |x|^{1/2}$: Without the loss of generality we may let the first coefficient $a_1$ of the innovation $\eta_{t-1}$ be equal to one. According to (2.2), $f_1(x) = \int |y|\phi(y - x)dy$ and $f_1^{(t)}(x) = (-1)^t \int |x + y|\phi^{(t)}(y)dy$. Then it is straightforward to verify that the regularity condition $C(t, \lambda)$ holds for all $\lambda > 0$ and nonnegative integers $t = 0, 1, \ldots$. From the inequality $||x| - |y|| \leq |x - y|$, condition (3.2) follows. (2) $f^{1/2}(x) = e^{x/2}$. Because the function $f(x) = e^x$ is smooth, it can be seen that the regularity condition $C(t, \lambda)$ also holds for all $\lambda > 0$ and nonnegative integers $t = 0, 1, \ldots$. For condition (3.2), we let $\tilde{X}_{1,m} = X_1 - X_{1,m}$. Then, for some $X_{1,m}^*$ satisfying $0 < |X_{1,m}^*| < |\tilde{X}_{1,m}|$,

$$\begin{aligned} E(f(X_1) - f(X_{1,m}))^2 &= Ee^{2X_{1,m}} \tilde{X}_{1,m}^2 e^{2X_{1,m}^*} \\ &\leq (E\tilde{X}_{1,m}^4)^{1/2} (Ee^{4(X_{1,m} + |\tilde{X}_{1,m}|)})^{1/2} \\ &\leq C \cdot E\tilde{X}_{1,m}^2, \end{aligned}$$

yielding condition (3.2). The last inequality above is due to the fact that there are two absolute constants $C_1$ and $C_2$ such that $E\tilde{X}_{1,m}^4 \leq C_1(\sum_{i>m} a_i^2)^2 = C_2(E\tilde{X}_{1,m}^2)^2$.

PROOF OF THEOREM 1. For a certain $\sigma^*$ such that $0 < |\sigma^* - \sigma| < |\hat{\sigma} - \sigma|$, we can express $\sqrt{n}(\widehat{SR} - SR)$ as

$$\begin{aligned}
&\sqrt{n}(\widehat{SR} - SR) \\
&= \frac{\sqrt{n}}{\hat{\sigma}}(\hat{\mu} - \mu) + \frac{(\mu - r_f)\sqrt{n}}{2(\sigma^*)^{3/2}}(\hat{\sigma}^2 - \sigma^2) \\
&= \frac{\sum_{t=1}^n f^{1/2}(X_t)\varepsilon_t}{\hat{\sigma}\sqrt{n}} + \frac{(\mu - r_f)}{2(\sigma^*)^{3/2}}\Bigg\{\frac{\sum_{t=1}^n f(X_t)(\varepsilon_t^2 - 1)}{\sqrt{n}} \\
&+ \frac{\sum_{t=1}^n (f(X_t) - \sigma^2)}{\sqrt{n}} - \frac{1}{\sqrt{n}}\Big(\frac{\sum_{t=1}^n f^{1/2}(X_t)\varepsilon_t}{\sqrt{n}}\Big)^2\Bigg\}. \qquad (3.5)
\end{aligned}$$

Define

$$\begin{aligned}
A_n &= n^{-1/2}\sum_{t=1}^n f^{1/2}(X_t)\varepsilon_t, \quad A_{n,m} = n^{-1/2}\sum_{t=1}^n f^{1/2}(X_{t,m})\varepsilon_t, \\
B_n &= n^{-1/2}\sum_{t=1}^n f(X_t)(\varepsilon_t^2 - 1), \quad B_{n,m} = n^{-1/2}\sum_{t=1}^n f(X_{t,m})(\varepsilon_t^2 - 1), \\
C_n &= n^{-1/2}\sum_{t=1}^n (f(X_t) - \sigma^2), \quad C_{n,m} = n^{-1/2}\sum_{t=1}^n (f(X_{t,m}) - \sigma_m^2),
\end{aligned}$$

where $\sigma_m^2 = Ef^2(X_{1,m})$. For any given three constants $c_1$, $c_2$ and $c_3$, let

$$S_n = c_1 A_n + c_2 B_n + c_3 C_n = n^{-1/2}\sum_{t=1}^n V_t$$

and

$$\begin{aligned}
S_{n,m} &= c_1 A_{n,m} + c_2 B_{n,m} + c_3 C_{n,m} \\
&= n^{-1/2}\sum_{t=1}^n V_{t,m},
\end{aligned}$$

where

$$V_t = c_1 f^{1/2}(X_t)\varepsilon_t + c_2 f(X_t)(\varepsilon_t^2 - 1) + c_3(f(X_t) - \sigma^2)$$

and

$$V_{t,m} = c_1 f^{1/2}(X_{t,m})\varepsilon_t + c_2 f(X_{t,m})(\varepsilon_t^2 - 1) + c_3(f(X_{t,m}) - \sigma_m^2).$$

By the Wald-Cramer device (3.1) follows if we can show that $S_n$ obey the central limit theorem with its limiting variance being the sum of those of $c_1 A_{n,m} + c_2 B_{n,m} + c_3 C_{n,m}$. Note that the last term inside the braces on the right hand of (3.5) is $o_p(1)$. It is clear that for fixed $m$, $\{S_{n,m}\}$ is a normalized sum of $m$-dependent and identically distributed sequence $\{V_{t,m}\}$ with $EV_{1,m} = 0$. The variance of $S_{n,m}$ is, by using (1.2) and **(A4)**,

$$\begin{aligned}
ES_{n,m}^2 &= c_1^2 Ef(X_{1,m}) + c_2^2[Ef^2(X_{1,m})][E(\varepsilon_1^2 - 1)^2] \\
&+ c_3^2\Big\{E(f(X_{1,m}) - \sigma_m^2)^2 + 2\sum_{i=1}^{m-1}(1 - i/n)E[(f(X_{1,m}) - \sigma_m^2) \times (f(X_{1+i,m}) - \sigma_m^2)]\Big\},
\end{aligned}$$

which is the sum of $\mathrm{var}(c_1A_{n,m})$, $\mathrm{var}(c_2B_{n,m})$ and $\mathrm{var}(c_3C_{n,m})$, and converges to

$$\xi_m^2 = c_1^2 Ef(X_{1,m}) + c_2^2[Ef^2(X_{1,m})][E(\varepsilon_1^2-1)^2] + c_3^2\Big\{E(f(X_{1,m})-\sigma_m^2)^2 + 2\sum_{i=1}^{m-1} E[(f(X_{1,m})-\sigma_m^2)\times(f(X_{1+i,m})-\sigma_m^2)]\Big\}$$

as $n\to\infty$. By the central limit theorem for $m$-dependent sequences, as $n\to\infty$,

$$\frac{\sum_{t=1}^n V_{t,m}}{\sqrt{n}} \to N(0,\xi_m^2). \tag{3.6}$$

Because of (1.2), $A_n$, $B_n$, $A_{n,m}$ and $B_{n,m}$ are all sums of stationary martingale differences. Hence

$$\begin{aligned} &E[(A_n-A_{n,m})^2+(B_n-B_{n,m})^2] \\ &\quad = E(f^{1/2}(X_1)-f^{1/2}(X_{1,m}))^2 + [E(\varepsilon_1^2-1)^2][E(f(X_1)-f(X_{1,m}))^2] \\ &\quad = o(1) \end{aligned}$$

as $m\to\infty$ (by **(A2)**). This, combined with

$$\lim_{m\to\infty}\limsup_{n\to\infty} E(C_n-C_{n,m})^2 = 0$$

(by **(A1) - (A3)**) as shown in Theorem 4.1 of Ho and Hsing (1997), implies

$$\lim_{m\to\infty}\limsup_{n\to\infty} n^{-1}E(S_n-S_{n,m})^2 = 0. \tag{3.7}$$

Hence, by arguments similar to those used in Theorem 4.1 of Ho and Hsing (1997), it follows from (3.6) and (3.7) that

$$\frac{\sum_{t=1}^n V_t}{\sqrt{n}} \to N(0,\xi^2) \quad \text{as } n\to\infty$$

with $\xi^2 = \lim_{m\to\infty}\xi_m^2$. Then, by Slusky's theorem, (3.1) follows. To show (3.4) we write

$$\begin{aligned} \xi_m^2 &= c_1^2 Ef(X_1) + c_2^2[Ef^2(X_1)][E(\varepsilon_1^2-1)^2] \\ &\quad + c_3^2\Big\{E(f(X_1)-\sigma^2)^2 + 2\sum_{i=1}^{m-1} E[(f(X_1)-\sigma^2)\times(f(X_{1+i}-\sigma^2)]\Big\} \\ &\quad + \sum_{i=1}^4 R_{m,i} \end{aligned}$$

where

$$\begin{aligned} R_{m,1} &= c_1^2E[f(X_{1,m})-f(X_1)] + c_1^2(\sigma^2-\sigma_m^2) + c_2^2E(\varepsilon_t^2-1)^2\times E[f^2(X_1)-f^2(X_{1,m})] \\ &\quad + c_3^2E[(f(X_{1,m})-\sigma_m^2)^2-(f(X_1)-\sigma^2)^2], \\ R_{m,2} &= 2c_3^2\sum_{i=1}^{m-1} E[(f(X_{1,m})-\sigma_m^2)-(f(X_1)-\sigma^2)] \\ &\quad \times[(f(X_{1+i,m})-\sigma_m^2)-(f(X_{1+i})-\sigma^2)], \\ R_{m,3} &= 2c_3^2\sum_{i=1}^{m-1} E[(f(X_{1,m})-\sigma_m^2)-(f(X_1)-\sigma^2)]\times[f(X_{1+i})-\sigma^2], \\ R_{m,4} &= 2c_3^2\sum_{i=1}^{m-1} E[f(X_1)-\sigma^2][(f(X_{1+i,m})-\sigma_m^2)-(f(X_{1+i})-\sigma^2)]. \end{aligned}$$

Because, by (3.2),

$$E(f(X_1) - f(X_{1,m}))^2 = o(m^{-2\beta+1}),$$

we have, as $m \to \infty$,

$$\begin{aligned} |R_{m,1}| &= o(m^{-\beta+1/2}), \\ |R_{m,2}| &\le C \cdot m \cdot E(f(X_1, m) - f(X_1))^2 \\ &= O(m^{-2\beta+2}), \\ |R_{m,3}| + |R_{m,4}| &\le C \cdot m(E(X_1 - X_{1,m})^2)^{1/2} \\ &= O(m^{-\beta+3/2}). \end{aligned}$$

Therefore, from (3.3) we have

$$\begin{aligned} \xi_m^2 \quad = \quad & c_1^2 Ef(X_1) + c_2^2[Ef^2(X_1)][E(\varepsilon_1^2 - 1)^2] \\ & + c_3^2\Big\{E(f(X_1) - \sigma^2)^2 + 2\sum_{i=1}^{m-1} E[(f(X_1) - \sigma^2) \times (f(X_{1+i}) - \sigma^2)]\Big\} \\ & + o(1) \end{aligned}$$

as $m \to \infty$. Since $\xi_m^2$ is already known to converge to $\xi^2$, it is necessary that

$$\begin{aligned} \xi^2 = \; & c_1^2 Ef(X_1) + c_2^2[Ef^2(X_1)][E(\varepsilon_1^2 - 1)^2] \\ & + c_3^2\Big\{E(f(X_1) - \sigma^2)^2 + 2\sum_{t=1}^{\infty} E[(f(X_1) - \sigma^2) \times (f(X_{1+i}) - \sigma^2)]\Big\}, \end{aligned}$$

which yields (3.4). The proof is complete.

### 3.2 Long-memory volatility

In this subsection we are focused on the case where the latent linear process $\{X_t\}$ is long-memory, that is, the $\beta$ given in (1.3) satisfies $1/2 < \beta < 1$. Set $\alpha = 2\beta - 1$ and $H = 1 - \alpha/2$. Then it can be seen that

$$\mathrm{cov}(X_t, X_{t+k}) = k^{-\alpha} D_1, \quad \text{with} \quad D_1 = D^2 \int_0^\infty x^{-\beta}(1+x)^{-\beta} dx$$

and

$$\mathrm{var}(\sum_{t=1}^{n} X_t) \sim 2\{(2-\alpha)(1-\alpha)\}^{-1} D_1 \cdot n^{2H}$$

(cf. Nordman and Lahiri (2005).).

**Definition.** A function $g$ is said to have power rank $k$ for some positive integer $k$, if $g_\infty^{(k)}(0)$ exists and $g_\infty^{(r)}(0) = 0$ for all $1 \le r < k$, where the function $g_\infty$ is as defined in (2.2).

In order to have asymptotic normality when the volatility is long-memory, we need the following assumptions.

**(B1)** $E\eta_1^8 + Ef^2(X_1) < \infty$. $f$ satisfies condition $C(t, \lambda)$ for some $\lambda \ge 0$ and for $t = 0, 1, 2, 3$.

**(B2)** The function $f$ has power rank 1.

THEOREM 2. *Suppose $X_t$ is long-memory, i.e., $1/2 < \beta < 1$. Under assumptions* **(B1)** *and* **(B2)**, *we have*

$$n^{1-H}(\hat{SR} - SR) \xrightarrow{d} \frac{(\mu - r_f)}{2\sigma^{3/2}} f_\infty^{(1)}(0) N(0, \delta_1^2) \tag{3.8}$$

*for some constant* $\delta_1^2 = 2\{(2-\alpha)(1-\alpha)\}^{-1} D_1$.

**Examples.** We use the same two examples as in Section 3.1, $f(x) = e^x$ or $|x|$, to illustrate Theorem 2. Assume again that $X_1$ is standard normal. As shown in **Examples** of Section 3.1 that the condition $C(t, \lambda)$ holds for all $\lambda > 0$ and nonnegative integer $t$. It remains to check if the function $f$ is of power rank one (as specified in **(B2)**). For $f(x) = e^x$, we have $f_\infty^{(1)}(0) = Ee^{X_1}$, which is clearly nonzero. For the other case of $f(x) = |x|$, we assume that the mean $\mu_1$ of $X_1$ does not vanish. By tedious calculation, we obtain

$$f_\infty^{(1)}(0) = \mathrm{sgn}(\mu_1)\Big(2|\mu_1| \int_{|\mu_1|}^{\infty} x\phi(x)dx + \int_{-|\mu_1|}^{|\mu_1|} x^2\phi(x)dx\Big)$$

which is non-zero. If $\mu_1 = 0$, then the corresponding power rank is two. Under this circumstance the asymptotic behavior becomes very complicated as the limiting distribution could be either normal or non-normal depending on the value of the memory parameter $\beta$ given in (1.3)(see Ho and Hsing (1997)). The issue will be explored in a future paper.

**Remark 4.** The limiting variances, $\delta^2$ and $\delta_1^2$, given above in (3.4) and (3.8) respectively, both depend on the linear filter $\{a_j\}$ and some parameters of the laten process $\{X_t\}$. It is a challenging problem to estimate the two quantities. For $\delta_1^2$ in Theorem 2, if the distribution function $F(\cdot)$ of $X_t$ is completely known, then one can use the sampling window method proposed in Hall et al. (1998) and Nordman and Lahiri (2005) to consistently estimate it. As for the short-memory case of Theorem 1, where a nonlinear function $f$ is involved, no existing results in the literature cover this case unless a certain kind of weak dependence is assumed. With only the summability condition on $\{a_j\}$ one needs to develop some new theory to support the use of the resampling scheme mentioned above.

PROOF OF THEOREM 2. Similar to (3.5), we first write

$$\begin{aligned}
&n^{1-H}(\widehat{SR} - SR) \\
&= \frac{n^{1-H}}{\hat{\sigma}}(\hat{\mu} - \mu) + \frac{(\mu - r_f)n^{1-H}}{2(\sigma^*)^{3/2}}(\hat{\sigma}^2 - \sigma^2) \\
&= \frac{\sum_{t=1}^n f^{1/2}(X_t)\varepsilon_t}{\hat{\sigma} n^H} + \frac{(\mu - r_f)}{2(\sigma^*)^{3/2}}\Bigg\{ \frac{\sum_{t=1}^n f(X_t)(\varepsilon_t^2 - 1)}{n^H} \\
&+ \frac{\sum_{t=1}^n (f(X_t) - \sigma^2)}{n^H} - \frac{1}{n^H}\Big(\frac{\sum_{t=1}^n f^{1/2}(X_t)\varepsilon_t}{\sqrt{n}}\Big)^2 \Bigg\}.
\end{aligned} \tag{3.9}$$

Each term except $n^{-H}\sum_{t=1}^n (f(X_t) - \sigma^2)$ on the right hand of (3.9) is $o_p(1)$, since $H > 1/2$. As for the remaining term, $n^{-H}\sum_{t=1}^n (f(X_t) - \sigma^2)$, it follows from Corollary 3.3 of Ho and Hsing (1997) that

$$\frac{\sum_{t=1}^n (f(X_t) - \sigma^2)}{n^H} \xrightarrow{d} f_\infty^{(1)}(0) N(0, \delta_1^2).$$

The proof is complete.

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# Development in the hedge fund industry: How has the industry evolved? An empirical study of the period from 1994 to 2004

## 1. Introduction

The hedge fund industry has grown at full pelt over the past decade, and was estimated to manage $2.787 trillion assets in Q4 2007. (Institutional Investor News and hedgefund.net release) Because of the distinctive characteristics of hedge funds, such as outperformance, low volatility, non-correlation with the traditional asset market, flexible trading strategy, exemption from regulation, and so on, they have been paid significant attention by investors and are widely discussed by academics. A great deal of literature analyzes the performance and characteristics of hedge funds, but less attention has been given to the development of the industry. In fact, many of the advantages and properties of hedge funds began to change over time, and this may be closely related to the current industrial environment and its evolution.

In a brief review of the relevant sentiments of the development trend in the industry, Shirrel (2000) observes fierce competition in the hedge funds industry. Completely directional funds, such as Macro and Short bias hedge funds, have especially fallen out of favor with investors, and have been substituted by non-directional or market-protected funds. Profit margins and investment opportunities have immediately shrunk due to competition, and Getmansky (2004) uses fund numbers and the flow variation of style categories to proxy for a degree of sub-industrial competition. When flows enter a favorable category or numbers rise, competition increases due to limited opportunities. Getmansky (2004) demonstrates that marginal funds are more likely to be liquidated than those which can offer desirable returns as competition increases, and Lo (2005) elaborates on hedge fund industry dynamics by means of the concept of ecology. He explains that hedge funds can accrue excellent and fitting managers through high-incentive compensation, and can be easily set up due to having low fixed costs and barriers for exiting. These factors have resulted in the competitive environment of the hedge fund industry. Darwinian selection works under intense competition, in that only successful hedge funds can survive and failed managers are eliminated after suffering a certain level of losses. The style of the investment strategies of hedge funds shifts dynamically in response to changing business conditions and competition, in addition to available profit opportunities.

Cohen (2006) points out that the shift in the composition of investors has changed hedge funds competition, risk/reward ratio, transparency and the mainstream of the

strategic style. Under monitoring by institutional investors, hedge funds are losing some of their rough edges and profit margins, although institutional capital is also helping the industry to bloom and mature. Esterling (2007) indicates that the hedge fund industry appears to be experiencing an expanding bifurcation, which means that the difference between larger and smaller funds is enlarging, and institutional investors are the main driving factor of this differentiation. Only large fund managers have sufficient capability to satisfy professional requirements, such as quantitative operation, risk mechanism, high transparency, and financial innovation, to attract institutional funds. Thus, different scales of funds also develop different business models to survive in their market segmentation. Large funds are more complex and small funds are simpler if anything. In other words, an M-shaped trend of asset scales in the hedge funds industry will be more evident in future.

Because prior studies present a positive perspective of the industry trend, we are interested in verifying these sentiments by providing empirical evidence. Previous opinions seem to induce two dimensions of industrial change, which include the composition of investors, the preference for a risk/reward profile, and the competitive degree of the industry. Our study investigates the trend of the ecological environment of hedge funds by discussing issues which have occurred during the past decade. The paper proceeds as follows. Section 2 describes the data set. Section 3 analyzes the change in the structure and the preference of investors. Section 4 discusses the industrial competition of hedge funds and the conclusion in Section 5.

## 2. Data description and basic statistics

### 2-1. Data description

Two sources were used for the empirical analysis, namely the TASS database and the Credit Suisse/Tremont (i.e. CS/Tremont) Hedge Fund Index and its ten sub-strategies index[1]. The Credit Suisse/Tremont composite index and sub-strategy indices are all asset-weight[2] portfolios of eligible funds, which have a minimum one-year track record, an audited financial statement, at least $50 million in assets under management[3], meet

[1] The Credit Suisse/Tremont Hedge Fund Index consists of a composite Index and ten style-based Sectors. The sectors include Convertible arbitrage, Dedicated short bias, Emerging markets, Equity market neutral, Event driven, Fixed income arbitrage, Global macro, Long/short equity hedge, Managed futures and Multi-strategy. The further information about the Credit Suisse/Tremont Hedge Fund Index refers to the website. http://www.hedgeindex.com.

[2] The assets under management (i.e. AUM) of hedge funds measured in US dollars. Hedge Funds with non-USD denomination would be converted into US dollar at month end by proper exchange rate.

[3] Some new funds do not satisfy the requirement of one year track record, they still take into the eligible funds if they meet the following condition. (1) AUM achieves USD 500 million or more or AUM comprises a portion of the top 85% of AUM for their sector,(2) they can provide audited financials or comparable verification of performance and AUM.

the Reporting Requirements, and have signed an agreement authorizing the use of their data and other confidential information. The eligible funds of the indices are rebalanced on a quarterly basis, and the indices are calculated on a monthly frequency.[4] These indices can be regarded as representing the portfolios of their sectors, and reflect the average behavior of allocated survival funds by major investors.

The TASS database is divided into two parts, namely "live" and "graveyard" funds. The live funds mean that they were actively working as of November 2004. Once hedge funds are liquidated, unable to be contacted, stop reporting their performance, are closed to new investment, or merge with other entities, they are transferred onto the graveyard database. The TASS database consists of monthly and net of fee returns, US-dollar assets under management (i.e. AUM), and other specific information relating to 4168 hedge funds between February 1977 and November 2004. In consideration of survivorship bias, sample funds were chosen which have a minimum track record of one year and were incepted after January 1993. Because the TASS database began tracking defunct funds in 1994, the graveyard database was not included since some funds dropped from the live database prior to 1994. However, defunct funds with more than one-year's track record and an inception date after January 1993 would be contained in the graveyard database if they satisfied the reasons for being transferred. In addition, we used the present monthly returns and the assets from the prior month to calculate the current assets for dealing with missing data. Finally, our sample consists of 3095 funds with 2518 individual funds, which include 1432 live funds and 1086 defunct funds, and 577 fund of funds (i.e. FOFs), which include 394 live funds and 183 defunct funds. In contrast with the Credit Suisse/Tremont Hedge fund index, we also form asset-weight portfolios based on the style category of all of the TASS data. We can further understand the dynamic behavior and development of the industry by analyzing the time series of returns for the CS/Tremont indices and formed portfolios.

### 2-2. Descriptive statistics

Table 1 reports the basic statistics for the empirical sample. Panel A demonstrates that the investment styles of individual funds are concentrated among four categories, namely Long/short equity (1,008), Managed futures (282), Event driven (274), and Emerging market (205). These four categories cover 70.3% of the total funds in the sample. However, Managed futures (61%) and Emerging market (52%) show a higher level of attrition than other categories, and Convertible arbitrage (25%), Multi-strategy (32%) and the Fund of funds (32%) show a low level of attrition. Panel B reports live

[4] The details about the credit Suisse/Tremont Hedge fund index rules can refers to the website http://www.hedgeindex.com

funds and exited funds with a mean and median of average monthly returns, volatility, maximum monthly gain, maximum monthly loss, and assets under management (AUM). Individual defunct funds generally demonstrate a lower performance, higher volatility and a smaller size than live funds. Generally, liquidated funds demonstrate poor performance, funds with no contact and no longer reporting have higher volatility than other types. Although the performances of no longer reporting funds are similar to those of live funds, they adopt a volatile operation to make a profit. They have up to twice the volatility and maximum monthly losses as live funds. If funds can keep more stable rewards through risky operation, they can attract more capital, such as no reporting funds. On the contrary, funds with an unsteady performance, such as no contact funds, cannot expand their fund size to maintain the survival threshold. This explain why no contact funds have small AUM, whether they are individual funds or funds of funds.

Panel C and Figure 1 display the monthly return and AUM for defunct funds over the last 12 months before exiting. We find that the performance of individual defunct funds, except stopping new investment or merged funds, begin to deteriorate prior to six months of exiting. The majority of them emerged with negative returns and decreasing patterns of AUM. In the case of FOFs, liquidated funds and no report funds still provide positive returns over 12 months before exiting. Relative to these, no contact funds and merged funds offered poor and volatile returns, so that their asset sizes did not expand. However, the common element of defunct FOFs is that their performance over the last 6 months before exit obviously became worse than it was in the past 12 months. Compared with individual funds, even though the fund of funds provided a positive return during the last six months, it would still be liquidated or closed. Thus it can be seen that investors of FOFs do not stand for more low or volatile gains than investors of individual funds, because they have paid double fees for diversification.

## 3. Investors' composition and preference

### 3-1. Investors' structure

According to the Bank of New York and Casey Quirk & Associates report[5], U.S. institutional investment in hedge funds was approximately $66 billion at the end of 2003, growing to $148 billion at the end of 2006. The global institutional investor capital in hedge funds increased from around $360 billion at the end of 2006 to more than $1 trillion in 2010, with institutions playing a more important role in the hedge fund industry than ever before. Investors' share of hedge fund investment flows is given in figure 2, where it can be seen that institutional demand for hedge funds was increasing, and achieved almost half of all inflows from 1997 to 2006. The individuals declined to 21% (from 61% to 40%) and the fund of funds increased by 9% (from 14% to 23%). The ratio of high–net-wealth individuals to institutions shifted from 6:4 to 4:6. These figures illustrate that the institutional investors have gradually become the driving force of the hedge fund industry.

### 3-2. Change of asset allocation by means of strategies and risk control

Institutional investors who are sophisticated experts tend to be conservative in their risk preferences and look for stable and safe returns as a result of complying with relevant regulation and meeting their commitment. They will select the funds with a comfortable strategy and characteristics by means of quantitative analysis and due diligence. Once the funds of their portfolios are unable to achieve target returns or incur an out of loss limit, they will immediately evaluate whether or not to adjust their positions. In contrast with institutional investors, high-net-wealth individuals, who put their money with funds managers and trust them to provide the promised returns, are generally more patient when they incur losses. Also, individual investors are generally less constrained in terms of fund selection and allocation. In order to detect the differences in behavior between individuals and institutions, we observed the time series pattern of asset flows into hedge funds by strategies and change of risk characteristics.

#### (1). Change of assets allocation by strategy

In order to understand the change of asset allocation by strategy, we observed the historical sector-weights pattern of the Credit Suisse/Tremont composite index at the end of each month from January 1994 to November 2004. We used the same way to calculate sector-weighs of sample data and took the monthly average for each year. The

[5] The researchers interviewed over 100 institutions and investment managers to understand perspective on institutional investment in hedge funds. They construct a model based on bottom-up approach and in consideration of opinions about all institutions with more than $100 million AUM to estimate current investment and forecast future value.

difference between both is that the former also reflects the weight of non-USD large funds, while the latter reflect the weight of USD medium and small funds. The k sector weight at year y is calculated as follows:

$$W_{k,y} = \frac{\sum_{t=1}^{12} W_{k,t}}{12} = \frac{\sum_{t=1}^{12} \frac{\sum_{i=1}^{N_k} AUM_{i,t}}{\sum_{i=1}^{N} AUM_{i,t}}}{12}$$

where $W_{k,t}$ is k sector weight at month t and $W_{k,y}$ is k sector weight at year y. $N_k$ is the numbers of k category funds. N is the numbers of all funds and $AUM_{i,t}$ is the assets of i fund at month t.

Table 2 and figure 3 illustrate the trend of sector weights of the Credit Suisse/Tremont hedge funds index between 1994 and 2004. It can be seen that Global macro funds dominated over half of the assets of the hedge fund industry between 1994 and 1996. Their weight declined from 56.7% to 15.6% between 1994 and 2000 and then kept near the 12% level. The capitals were transferred to Long/short equity and Event driven, although three categories managed approximately 80% of the capitals of the industry in the year 2000 ago. The weight of Long/short equity achieved its peak in 2000, and drastically reduced as the technology bubble burst. The capitals flowed into the other styles so that the weights slightly grew in the early 2000s, with the Multi-strategy especially being converted into one of the main investment styles since 2003. From the weight of assets allocation over time, the major strategies of hedge funds could be seen to have shifted from directional betting (ie.market timing approach) to non-directional or a hybrid style of both. Investors' demand for hedge funds reflected a low risk requirement. This result agrees with Shirrel (2000), who points out that investors started to care about risk more and more, and gradually preferred to diversify risk or seek mispricing strategies.

Table 3 and figure 4 illustrate the trend of sector weights of the composite portfolio by the TASS sample between 1994 and 2004. The pattern and allocation of sectors have some differences relative to the CS/Tremont hedge funds index. The source of the difference may be the lack of non-USD large funds and the fact that all medium and small funds are included in our sample. The category with a great deal of numbers has a larger aggregation of AUM and its weight in composite portfolio is relatively raised. However, the weight of the CS/Tremont indices is not affected by ineligible funds with an AUM of less $50 million. We find that asset allocation was concentrated on three categories, namely Long/short equity (21.2%-27.3%), fixed income arbitrage

(14.7%-15.3%), and Emerging market (19.4%-25.5%) before 1997. Throughout the Asian financial crisis and the dot com bubble, the allocated proportion of the three strategies decreased from 60% to 40%. Only the sector weight of Event driven and Convertible arbitrage sustained growth over time. Nevertheless, the development of asset allocation for strategy was gradually balanced and diversified.

**(2). Change of risk preference**

We observed the time series trend of volatility based on the CS/Tremont composite index and asset-weight portfolio of the TASS sample, which are regarded as the sector-weight volatility. If a downward trend of volatility is demonstrated, this may explain a more cautious risk preference for investors. However, the equity market volatility has gradually dwindled since the year 2000, and we also observed the trend of volatility spread[6] between hedge funds and the S&P 500 index. If the volatility spread reveals a downward or stable pattern, this can also reflect a low risk requirement of investors.

Figures 5 and 6 illustrate the time series trend of sector-weight volatility and volatility spread over the S&P500 index. This demonstrates that the pattern of sector-weight volatility has changed in two stages. An upward trend of volatility exists between 1994 and 1998, peaks at 12.32% in 1998, after which there is a downward trend, keeping at a low level of approximately 2.5%-3.5% after 2001. The pattern for the composite portfolio of the TASS sample is consistent with the CS/Tremont index and has a lower volatility due to the difference of the sector weights between both before the year 2000, particularly for the Global macro. In contrast to the pattern of the S&P 500 index, it takes on M-shaped, double peaks at 21.48% in 1998 and at 20.61% in 2002. A negative spread of volatility exists and during all of the calendar time, except for 1995 and 1996. This illustrates that the returns of the hedge funds industry are volatile, the same as the equity market in the early 1990s and, although this does not satisfy the image of low volatility, it changes after 2000. The negative volatility spread is expanded and the difference can be perceived by comparing the spread level in two peaks and bottoms. When the first peak is 21.48% in 1998 and the second peak is 20.61% in 2002, the corresponding volatility spread is –9.16% and -17.83% respectively. The former is almost twice the latter under close levels of peak. When the first bottom is 5.12% in 1995 and the second bottom is 7.25% in 2004, the corresponding volatility spread is 2.19% and -3.84% respectively. Even the traditional asset market is fluctuating less. The fund managers could not use risky trading to earn the promised profits as they did before because more volatile funds could not attract inflows after 2000. This means that

[6] Volatility spread is defined as volatility of the hedge funds minus volatility of the S&P 500 index.

the investors executed a low volatility demand by their choice of investment strategy after 2000, which indicates that the risk preference of investors had, indeed, changed.

**(3). Change of performance request**

Figure 1 indicates that the performance of liquidated funds begins to deteriorate prior to six months of liquidation. As a rule, underperformance is still the major reason for the liquidation of funds. If the pattern of returns prior to six months of exit shows an upward trend over calendar time, this indicates that investors are less patient to undertake a loss than before, and that they are becoming more and more rigorous for the required returns. We calculate the 6-months and 12-months buy and hold returns prior to liquidation for each fund, then take the median return for each semiannual (annual) calendar time. We observe the trend of the median return instead of the mean return because the mean return is easily affected by extreme values. The formula for the buy and hold return of M month is as follows:

$$RET_{i,M} = \left[(1+r_{i,T})(1+r_{i,T-1})\ldots\ldots(1+r_{i,T-M-1})\right]-1$$

where $r_{i,T}$ is monthly return of i fund at liquidated month T.

However, a problem exists in that the absolute return of each liquidated fund in the same exiting year may express the performance of a different holding period. For example, fund A is liquidated in June 1998 and fund B is liquidated in December 1998. Fund A and fund B, which are both subsumed in the 1998 group, have the same 12-month buy and hold return as –5%, but the former reflects the performance of 1997, while the latter reflect the performance of 1998. Hence, we can use an excess return to resolve this problem. An excess return[7] is defined as fund returns subtract the corresponding CS/Tremont style benchmarks. We plot the time series pattern of median returns for each of the semiannual and annual samples according to the fund's month of liquidation.

In Figures 7 and 8, there appears to be no obvious trend for the median level[8] of 6-month returns between 1995 and 2004[9]. If we observe this trend in two stages, we can find an interesting phenomenon. A downward trend exists before the year 2000 with three peaks, the median returns of which are 1.4%, 0.72%, -0.96% respectively. In contrast with the benchmark, the semiannual returns are up 10% among the three time points. (For detailed figures see Table 4). This means that the funds inferior to most competitors during a boom market are liquidated, even though they earned a small gain

[7] It calls relative return or active return. The active return is defined as the difference between the return of the fund and the return of style benchmark index.

[8] The trend for mean level of 6-month returns is consistent with median level whether absolute returns or excess returns.

[9] We drop the value of 1994 because sample size is too small to be representative.

or did not make a loss. Proceeding to the second stage after 2000, this displays an upward trend over time with peaks concentrated between 2003 and 2004, when the range of median returns is from -0.88% to 0.47%. However, in contrast with the benchmark, the returns range between 2.93% to 7.94%. As the global recession arrives, and the number of competitors increases, it is more difficult to trade and make gains during this phase than it was before. Nevertheless, investors are more and more unwilling to stand for those funds which make losses or earn small returns. In figure 8, which indicates the trend of excess returns, we find that the median return of liquidated funds moved upward and then kept the level of underperformed by 5% of their style benchmarks after the third quarter of 2001. Figures 9 and 10 compare two peaks (-1.69% in 1996 vs. 1.26% in 2004) and their corresponding benchmarks (22.2% vs. 9.64%). The pattern of 12-month returns increases over time and is, on the whole, consistent with the 6-month case. The excess returns have gradually reduced and have converged on the -10% level since 2001. (For detailed figures see Table 5). This evidence demonstrates that investors were becoming more rigorous for required returns than before, and that if the funds could not offer the promised performance, investors would rather withdraw their capital than give more waiting time in the even then bad market condition. So the behavior of investors had changed in terms of required returns and the degree of undertaking loss.

## 4. Change of competition

Hedge funds, which have distinct characteristics compared with the traditional asset instruments, attract a great deal of flow into the industry and have become the hottest alternative investment over the past five years. Nowadays the hedge fund industry is still in the growth stage of its lifecycle but its survival environment is more arduous, due to increasing financial market uncertainty and competition[10]. Thus, we observed the pattern of failure rate, profit persistency and protection capability to detect the change for competition.

### 4-1. Failure rate

#### (1). Change of attrition rate, failed rate and liquidation rate

Table 6 provides the numbers and proportion of defunct funds of each exit type during the calendar years spanned by the sample period. The numbers of total exited funds have apparently increased since 1998 and were underestimated in 2004[11]. The average proportions of liquidated and no longer reporting funds to the total funds are 54.7%, 29.37% respectively (i.e. the fund of funds case is 51.91%, 33.88%). However, both are major types of exit for individual hedge funds and FOFs.

The attrition rate definition is the ratio of defunct funds, which were active at the beginning of the year but have exited during the year, to living funds at the beginning of the year. The liquidation rate is a similar concept and simply replaces the numbers of defunct funds with liquidated funds. Table 7, Panels A and B, report the attrition rate of individual funds in each category. The attrition rate gradually rises over time and its average value is 9.53%. The attrition rate steadily maintains 10% to 12% after 1998, but the peaks of each style are almost all concentrated on two periods between 1997-1998 and 2000-2001, which reflect the three shocks of the financial markets, namely the Asian crisis, LTCM collapse and the burst of the technological bubble. The Emerging markets and Fixed income markets were widely struck and adjusted by the first two shocks and the technological bubble slashed the equity markets. Throughout the weeding-out process during two or three years, the attrition rate decreased to the normal level. Overall, the average attrition rate varied for each strategy, with the largest rate at 15.27% for Managed futures, and the lowest rate at 4.23% for Convertible arbitrage. The competition of the hedge funds industry slightly increased over time according to the overall trend of the attrition rate.

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[10] New competitors extensively include new hedge funds, mutual funds, private funds and investment banking with imitating trading mode and strategy of hedge funds.

[11] TASS database has the waiting time about 6 to 8 months before moving no longer reporting funds form live to graveyard database, so the numbers of exiting funds maybe are underestimated and the proportion of liquidation overestimated in 2004.

However, interesting behavior may be seen among the sub-industries if we observe the changeable pattern of the attrition rate, dollar flows[12] and buy and hold returns for each strategy at the same time. Panel E reports the dollar flow, new entrants and the buy and hold return for each strategy during three periods, utilizing the time point of the financial shocks to divide the three phases. The first period (1994-1997) was when hedge funds began to spring up and received the attention of investors. Due to the global economic revival after the Mexican crisis of 1994, there were well performing and positive dollar flows for each strategy in the sprouting period. The top three categories of dollar inflows were Long/short equity (24%), Fixed income arbitrage (16%), and Emerging market (16%). The second period (1998-2000) reflected the influence of shocks, such as the Asian crisis, LTCM collapse and forming bubbles, for each category of hedge funds. At this stage, the top three categories of dollar inflows are Long/short equity (65%), Event driven (18%), and Equity market neutral (14%). The last period (2001-2003) was the maturity phase in which investors commonly perceived hedge funds, being more cautious about investing during the bubble modification. The top three categories of dollar inflows were Convertible arbitrage (18%), Event driven (15%), and Fixed income arbitrage (14%)

It can be seen that, if investors blindly pursue category returns and increase flows into hot sub-industries, then competition in the sub-industries rises due to an increase in entrants, limited opportunities and a decreasing scale of return. A great deal of inflow also pushes ahead with bubbles for favorable sub-industries. Following intense competition and the market trail, the average returns of favorable sub-industries fall and begin to weed out the marginal funds, suffering from loss and income deficit. Then attrition rate and outflows achieve a peak at this time, and only the fittest funds can survive during elimination. The average performance and flows increase after the selection of the competing process, the attrition rate drops, and the dynamic cycles constantly recur among the sub-industries. Thus, we show one example to illustrate the chain effect due to competition change.

Emerging market funds earned a 66.82% return (i.e. the annual return is 16.71%, ranked four among ten categories), the annual attrition rate ranged from 0% to 6.45%, increased by 113 new entrants (i.e.13% of all new entrants, ranked 2) and attracted US 5.974 billion (i.e. 16% of all dollar flows, ranked 3) between 1994 and 1997. After the shock

[12] The measure of dollar flow is defined as change of net assets after subtracting profit during current period. The formula is as follows: Dollar $flow_t = Asset_t - Asset_{t-1}(1+r_t)$ where $Asset_t$ is the terminal assets at time t , $r_t$ is the monthly return at time t

of the Asian crisis and the LTCM collapse, Emerging market funds lost 15.75% return (i.e. the annual return is –5.25%, ranked 10), the annual attrition rate suddenly rose and ranged from 12.93% to 18.18%, and there was an outflow of US 2.547 billion (i.e. -9% of total dollar inflows, ranked 10) between 1998 and 2000. After elimination by means of competition and adverse market conditions, the returns gradually recovered and the attrition rate rapidly decreased. Besides, another reason for mitigated competition was that new entrants and inflows still stayed at a low level between 2001 and 2003. Other cases, such as Global Marco, with Fixed income arbitrage in the first period, Long/short equity in the second, and Convertible arbitrage in the third period, were patterns which were obviously the same as Emerging market. In other words, the industrial environment of funds was affected by the preference and capital of investors transferred among sub-industries. This phenomenon corresponds with the empirical results of Getmansky (2004). The inflows helped to decrease the liquidation probability of funds, but competition substantially raised the probability of liquidation. Therefore, some funds without poor performance were still liquidated due to high competition, an unfavorable strategy, or both. Funds with more competitive capability than others were the key factors of survival. These cases demonstrate the dynamic competition effect for hedge funds across each strategy, and the main strategy varied over competition and market conditions.

Defunct funds do not mean that they fail and stop working, except for liquidated funds, which are explicitly terminated and regarded as being dead funds. Since hedge funds cannot advertise, many voluntarily release information to a database for attracting new investors before achieving optimal size. When they do not need new capital, or consider their reputation during a market slump, they may stop providing any information to commercial databases. Many studies also point out that the failure of hedge funds was highly concentrated among relatively small size and poor performance funds. Hence, with the exception of liquidation, some defunct funds can be regarded as having similar characteristics as live funds and their attrition rate can be calculated again. If the defunct funds satisfy all of the following conditions, which mean that their recent performance and size have maintained the basic requirements, like general live funds, they are then transferred to live funds. The principles are a positive 6-month absolute return and outperforming the responding benchmark before exit, a positive average return, and at least 10 million[13] in AUM at the end of exit. There are only 33 defunct funds which

[13] We used two criteria to screen the potential live funds. If the funds satisfy two criteria, it means that funds have relatively less pressure of immediate closure. The first one is 10 million of AUMs, which corresponding to the quantile of distribution for the defunct funds at the end of exit and the live funds at the end of 2004 is 55% and 20%, to be basic survival threshold. The other one is no worse sign of recent performance.

satisfy the above conditions and can be regarded as being live funds. Table 7, Panel C and Panel D, report the failure rate and liquidation rate of individual funds and each strategy. Basically, the pattern of the failure rate and liquidation rate are consistent with the attrition rate over time and the literature mentioned.

The average annual value of the failure rate and liquidation rate are 8.53%, 4.72%, respectively. Eastrling (2005) argues that the failure rate of hedge funds is overestimated by academics, and estimates are close to 5% by practitioners. The value is close to the annual liquidation rate, which ordinarily keeps to 4%-5% but abruptly increased to 7.56% in 1998. Relative to other strategies except Managed futures, Equity market neutral funds have a high-liquidation rate.

**(2). Change of mortality rate and survival time for young funds**

Brown, Goetzmann & Park (2001) found that half of TASS hedge funds (1989-1998) could survive for more than 30 months, and Amin & Kat point out that some funds have survived for more than five years. Generally original external investors would revaluate the holding funds after a lock-up period, a provision of one-year for most funds, and give a buffer period which they could bear with a limited time for poor performance. New investors would seek targets which were performing well enough and which had sufficient information of a track record for due diligence. Young funds with a mediocre performance found it so hard to expand their AUM that they could not exceed the survival threshold[14]. According to the sample data, half of defunct funds are closed after less than 40 months and the average survival time is 46 months. If the industrial environment competes more and more, investors will have a wider and more flexible choice of target investments and can reduce the length of the buffer period. When young funds perform badly, there is a greater possibility of early termination. Thus, we expect to see an upward trend of defunct ratio and a downward trend of survival time for young funds.

We observed the mortality rate and survival time of defunct funds during an N year sample period after the year of inception. For example, in tables 8 and 9, the numbers of newly established funds in 1993 are 136, and the number of exited funds are 43, 31 of which were liquidated between January 1994 and December 1997 (i.e. n= 4y). The broad mortality rate in 1993 is 33.09% (i.e. the narrow mortality rate is 22.79% when only calculating liquidated funds) and the survival duration is 36 months. This means that a third of the young funds have exited within four years and investors are given

[14] If the fund is unable to achieve survival threshold , then it does not have enough fee income to cover operating cost and attract excellent traders for upgrading trading skill.

three years for buffer periods. Another sample period uses the same way to calculate the survival time and the mortality rate. In contrast with the year 2000, the numbers of newly established funds are 255, and the number of exited funds is 95 of which 53 are liquidated between January 2001 and November 2004 (i.e. n= 4y). The broad mortality rate is 37.25%[15] (i.e. the narrow mortality rate is 20.78%) and the survival duration is 32 months. We also run the linear regression of the mortality rate and calendar time to verify the trend direction. It can be seen that the broad mortality rate for individual funds is increasing and the survival time is decreasing over time. This trend is significant when the sample periods are above two years, and this means that it is more difficult for young funds to survive than before and they need to achieve the survival threshold by shortening the time they take to beat competitors. However, this pattern does not hold in the case of the fund of funds. Because the fund of funds is less risky than individual funds because of diversification, the waiting time may be longer for paying double-fee investors.

### 4-2. Profit squeeze

#### (1). Trend of excess returns

Furthermore, we would like to understand whether or not the profit-making space of hedge funds is compressed due to changes in the competitive environment. When competition becomes fierce, the difficulty of earning abnormal profits for hedge funds will gradually increase, even though hedge funds emphasize the characteristic of providing absolute returns whether the market condition is good or not. Figure 11 illustrates the trend of cumulative returns for hedge funds vs. the S&P 500 index between January 1994 and November 2004. Basically the pattern of absolute cumulative returns for hedge funds rises steadily over time but, because of the LTCM incident, the upward trend dropped sharply and fell to a relative low in October 1998 and then rebounded and grew. In contrast to the pattern of the S&P 500, superior to hedge funds before the year 2000, the pattern reversed and declined sharply from August 2000 because of the dot com bubble modification. Hedge funds outperformed the S&P 500 after August 2000. From the perspective of absolute returns, the profits of overall hedge funds sustained growth over time, but the shortcoming of absolute returns does not take compensation for risk into account, and most institutional investors generally observe the alpha, which is the measurement of excess performance over benchmark. Thus, we employ the Fama-French (1993) three factors model to obtain the alpha and the data of three factors downloaded from Professor Kenneth R. French's

[15] The numbers of exit and survival time of the defunct funds may be underestimated due to waiting time being roughly 6 to 8 months from the live to graveyard database. Thus, some funds without reporting or contacting now still put in the live database.

website[16]. This model is as follows:

$$R_t - R_{f,t} = alpha + \beta(R_{m,t} - R_{f,t}) + b_1 SMB_t + b_2 HML_t + e_{i,t}$$

$R_t$ is the monthly return on a portfolio of Hedge funds (i.e. CS/Tremont index, TASS sample) at the time t, $R_{f,t}$ is the 30-day treasury bill rate, Rm-Rf is the excess return on the market[17], SMB is the monthly average return on small portfolios minus the average return on large portfolios, HML is the average return on the value of the portfolios minus the average return on the growth portfolio[18]. We estimated the alphas, employing separate rolling 12 months, 36 months and 60 months windows, then plotted the 60 month trend of the alpha between November 1994 and November 2004 and investigated whether or not the trend of the excess returns would decrease progressively over the years.

Figure12 indicates the trend of the alpha of the CS/Tremont hedge funds index employing a rolling 60 months window. Whether we used the S&P 500 index or a composite portfolio of all of the NYSE, AMEX, and NASDAQ stocks from the CRSP to proxy for the market factor, they showed positive alphas and a consistent trend. The peak occurred in the first quarter of 2000, and then we observed a downward pattern of the alpha with the cycle continuing until the second quarter of 2003. Figure 13 illustrates the trend of the alpha of the CS/Tremont hedge funds index and the value-weight of the TASS portfolio. Both are roughly similar patterns and there is a great difference from the first quarter of 2003. The value-weight of the TASS portfolio has higher alphas than the CS/Tremont hedge funds index during 2003, and begins to converge in the first quarter of 2004. The difference[19] results from some categories, such as the Emerging market, Multi-strategy, Short bias, Managed futures, outperforming the CS/Tremont index. This means that small and medium size funds offered a better reward than large size funds in these categories during 2003.

Table 10 displays the R square distribution of each category of hedge funds by employing the Fama-French three factors model for a rolling 60 month window. The tree risk factors can explain 50% to 60% of the variation of returns for individual hedge

[16] The definitions and calculations of the three factors refer to the following website. http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_factors.html

[17] (Rm-Rf) is a value-weight return on all NYSE, AMEX, and NASDAQ stocks from CRSP minus the one-month Treasury bill rate.

[18] The stocks with the high book-value to price ratio are called value stocks and their opposites are the growth stocks.

[19] The difference of alpha between the CS/Tremont and the value-weight portfolio of the TASS sample during the first quarter of 2003 to 2004 refers to appendix Table A2.

funds and FOFs. Of course, the three factors model does not fit non-equity strategy funds such as Managed futures, Fixed income arbitrage, Global macro, and account should be taken of the bond and economic risk factors in the model.

Table 11 shows a significant proportion of each category of hedge fund by employing the Fama-French three factors model for a rolling 60 month window. The significant proportions of the individual hedge funds and FOFs of the TASS portfolio and the CS/Tremont index are 67%, 29%, 21% and 19% at $\alpha$=10%. Because the significant proportion of the TASS portfolio is higher than that of the CS/Tremont index, we further analyze the alpha trend of each category of the TASS portfolio.[20] The significant proportion of main styles such as Event driven, Long/short equity and Multi-strategy are above 85%.

Figure12 exhibits the alpha trend of each strategy of the TASS sample[23] by employing a rolling 60 month window. The pattern of most strategies is consistent with the overall hedge funds, which show a positive alpha and downward pattern from 2000 to the second quarter of 2003. Through the weeding-out process of competition, the excess returns for hedge funds rebound in 2003, and then turn down slowly. But the special cases are Multi-strategy, Emerging market and managed futures, with upward trends. In terms of the emerging market, through the shocks of the Asian crisis and knocked out failures, the absolute and excess returns gradually recovered their losses, and increased as the competition slowed down. It was found that the alpha pattern of multi-strategy was nearly the same as the FOFs but offered more than 0.3% excess return per month (i.e. an annual rate of 3.6%) more than the FOFs. From the AUM allocation we know that multi-strategy funds have converted into one of the main investment styles since 2003, which has satisfied the investor's demand to offer smooth returns by employing several strategies to add diversification benefits and reduce the single strategy and asset-market risk. Furthermore, investors do not pay them double fees like the FOFs. Therefore, we expect the multi-strategy funds to gradually partially substitute the FOFs

[20] The estimation of alpha for each strategy, which employs the Fama-French three factors model at the end of each year during 1994 to 2004 , shows in the appendix Table A1.

[23] The sample period of calculating 36 month correlation in September 1997 is from September 1994 to September 1997. The same is as January 2000, which reflects the correlation between January 1998 and January 2000. Therefore, the sample period of calculating moving average correlation is from September 1994 to January 2000.

and attract institutional flow, although elimination may come violently through competition. Indeed, the difficulty of earning excess returns for all hedge funds increased after 1998 because more investors and competitors began to participate in this shining industry.

**(2). Change of successive profit time**

We also used another view to detect the change in the competitive environment. If competition is becoming fierce, the difficulty in successively earning positive returns for hedge funds will increase. In other words, the interval between incurring losses will be reduced and show a downtrend over time if the environment is more competitive. We used a simple linear model to test the issue as follows:

$$\ln(M_{k,t}+1) = \alpha + \beta * \ln(time_k) + e$$

$M_{k,t}$ is the interval between the *k-1*ith and *k*ith losses, which occurred at time t, and $time_k$ is the calendar time the *k*ith loss appears. If the beta coefficient is significantly negative, this means that the frequency of profits has diminished over time and fund managers need to exert more effort than before. It also implies that the overall environment for hedge funds may be competitive for some time.

Table 12 presents the test results, which indicate that most of the beta coefficients for each category are positive except for Short bias. However, the interval between incurring losses shows no significant change or trend, whether in the TASS sample or the CS/Tremont index. The interval time of successive gain is significantly increasing over time, but only for equity market neutral and fixed income arbitrage at $\alpha$=10%. Because they have the attributes of fixed income products, investors are generally more conservative and invest in them as a substitute for traditional bond allocation. In order to satisfy investors' demand, low volatile and positive returns are always provided under general market conditions. Losses were nearly occurred during great financial events, such as the LTCM collapse and thus, we are not surprised at their upward trend. Broadly speaking, we have no evidence to support the claim that the hedge funds industry is more competitive by the trend of successive profit times.

## 4-3. Protection capability

**(1). Downside Protection under general market conditions**

Some studies report that one of the valuable characteristics of hedge funds is downside protection from financial shocks. Fung & Hsieh (1999) point out that some categories of hedge fund provide a floor value for the downside market. For example, the trend

following CTAs has a U-shaped payoff like a straddle option, for obtaining a large profit during extreme market conditions. The Global macro has a similar payoff to collars, to outperform the equity market in downturn and underperform in an upward condition. Edwards & Caglay (2001) also find that commodity funds offer better downside protection than hedge funds, which demonstrates a more positive relationship with the U.S equity market in a bear market rather than a bull market. The Credit Suisse (2007) also reports that the majority of hedge funds can better withstand market shocks and keep a positive performance over a one year period following financial events such as the Asian crisis, the LTCM, the burst of the technological bubble, and the 9/11 attack. Because hedge funds need to maintain a limited correlation with equity markets, they generally anticipate partial upside gains during a bull market and preserve downside protection during a bear market. We are, thus, interested to know whether the protective capability of hedge funds changes over time. If the function of the protection gradually weakens over time, this may imply that the survival environment for the hedge fund industry tends to be more competitive or unfavorable.

Firstly, we can understand the effect of sharing upward gains in a hot market and protecting capital in a slumped market by observing the pattern of each sub-sector of hedge funds for a rolling 36 months correlated with the S&P 500 index. Moreover, we can also calculate the correlations under different market conditions. Up market means that only a correlation with non-negative returns of the S&P 500 is calculated, along with corresponding returns for hedge funds during 36 consecutive months, and then the trend is plotted over time. The down market follows the same concept as the up market and only picks out the sample points of negative returns for the S&P 500. If the hedge funds provide the obvious function of avoiding falling losses and anticipating rising profits, we expect positive correlations to appear during a bull market and negative or no correlations to appear during a bear market. In addition, if the participation in bull market become aggressively, it will observe the upward trend of the correlation over time; likewise it will observe the upward trend of correlation if the downside protection weakens over time. This is also regarded as an indicator that the survival environment is becoming hard if the protective effect persistently weakens. Due to the pressure of competition, funds may sacrifice security to obtain a good performance by taking active operation.

Figure 13 provides a pattern of the CS/Tremont hedge funds' composite index and the asset-weight portfolio of the TASS sample by employing a rolling 36 month correlation with the S&P500 index. We observe some jumps, which are the result of exiting or taking account of the sample period of the great financial incidents, such as the Asian

crisis in July 1997, and the LTCM collapse of August 1998. If we ignore a few gaps, we find that the pattern of correlation with the S&P 500 can roughly be divided into three phases, the first of which is when the 36 month correlation fluctuates between 0.6 and 0.7 during the bull markets between September 1997 and January 2000, when the S&P 500 gained 47%. The average correlations for the TASS sample and the CS/Tremont index are 0.62 and 0.65 respectively. Then the link reduces after the year 2000, and the correlation swings between 0.4 and 0.5 during the bear markets between April 2000 and September 2002[25], when the S&P 500 dropped 43% due to a bubble modification. The average coefficients of correlations of the TASS sample and the CS/Tremont index are 0.49 and 0.41 respectively. As the economy revives, the correlations rise again and continue to rise from 0.5 to 0.6 after 2003, when the S&P 500 rebounds to 39.5% and the average correlation for the TASS sample and the CS/Tremont index are 0.58 and 0.5 respectively. For both the TASS sample and the CS/Tremont index, the pattern and value of the overall hedge funds are closed and consistent before August 2000, which is the peak of the S&P 500 index. By the time the peak falls to the bottom in 2003, the time series trend of the CS/Tremont index has moved down and is far lower than the TASS sample, the downward trend of which is not obvious. The Long/short equity mainly contributed to the difference of both, due to being allocated more weight of AUM and numbers among the hedge fund industry. This pattern also implies that relative to medium or small funds of Long/short equity and larger funds limit the correlation with the equity market and control the downside risk in order to satisfy the demand for institutional investors during the adjustment of bubbles.

Furthermore, from figures 14 and 15, which report the time series trend of the correlation with the S&P 500 index and the Nasdaq, we can observe that the funds of Long/short equities gradually decrease their market exposure and link after 2000. But it is interesting to note that hedge funds correlate very highly with high-tech stocks before the bubbles burst, and sharply reduced their links as the Nasdaq crashed. Even though the market of high-tech stocks fell and rebounded sharply during 2003, the funds did not anticipate the springing gains. This phenomenon is probably explained by the empirical results of Markus & Stefan (2004), which find that hedge funds adopt
a strategy of riding bubbles instead of using the correcting force of technology bubbles. Hedge funds did not attack bubbles. Instead of driving power, they bought overpriced stocks to capture the upturns and reduce the exposure of high P/E stocks before the price collapsed[26]. If managers can predict the fact that bubbles eventually burst and

[25] the sample period of calculating moving average correlation is from April 1997 to September 2002.
[26] They find that the portfolios of large hedge funds hold heavy proportion of high P/E technology stocks relative to market portfolio weights during 1998 to 2000, but their technology exposures top in September 1999, about 6 months before the peak of bubbles, then begin to cut positions for avoiding

prices are modified to a fair level, they will exploit the profit opportunities by raising the price as long as it make enough excess return to cut the positions before a market breakdown.

Figure 16 shows the pattern of the correlation of the S&P 500 index and the CS/Tremont sub-sector indices and asset-weight TASS portfolio, respectively. The patterns and values of both are roughly consistent, except for Global Macro, which has shown a great gap and a different trend since the first quarter of 2001. Generally, we can class the three parts by relating the pattern to the equity market, as follows:

(i). The pattern is similar to the market trend, with the overall average keeping above 0.4 or below -0.4 level, such as the Emerging market, Long/short equity, Multi-strategy, Event driven, Fund of funds and Short bias. The pattern of the Emerging market, Multi-strategy and Short-bias tends to maintain stability and varies without the market condition. However, others adjust the correlation with the equity market situation and preserve the protection for a downturn.

(ii). The correlation pattern showed inverse U-shaped and positive value over time, such as Equity market neutral, which is an obvious example of loss protection. Its correlation trend is almost identical with the market trend before 2003, with the correlation increasing as the market rises and decreasing as the market drops. However, the correlation still decreases close to zero after 2003, even though the equity market started to move up. Because this category emphasizes the neutral market exposure, its links with the equity market have progressively decreased since the bubble modification. By previous results, the equity market neutral exhibits significantly positive alpha over time and successive profit time. Thus, this strategy fund seems to regard controlling risk and security as being the first important task.

(iii). The funds are low or uncorrelated with the equity market and the fixed income market[27], such as Fixed income arbitrage and CB arbitrage. However, their patterns do not obviously change with the asset market violation. This phenomenon may be partially explained by Lo (2004)'s empirical result, which found that some categories of funds, such as fixed income arbitrage, CB arbitrage, event Driven and so on, exhibit high serial correlation due to their portfolio of illiquid securities. Their reported returns tend to be smoother than their true value and understate their volatility and correlation with the market. However, they appeared to have a significant negative correlation with

much of the downturn in future.

[27] We take the Salomon US Treasury 5 Year index for proxy to the fixed income market.

the fixed income market during the period 1998-2001, which a great deal of capital inflow to the safe US bonds market. Their performance was also hurt after the LTCM collapse. This did not preserve an obvious protective function for the asset markets, although the large fixed income arbitrage funds tended to increase their link with the US bond market and participate in gains after 2001. They seemed to be operating more conservatively than before.

Briefly, the trend of correlation is similar to the price movement of the US equity market. And the correlation increases to limit level during the bull market and decreases before market slump. It implies that the hedge fund has better risk awareness. Furthermore, the participated and protective effect of the bull market and bear market can be seen in figure 17. The correlations of the down market always dominate the up market for funds which high correlate with the equity market (i.e. Long/short equity, Event driven, Multi-strategy, and Fund of funds). The trend of correlation decreases in the up market, and even drops to a negative value, over time.

In terms of the participating side, the hedge funds raise high alertness for risk and decrease the exposure to stop gains during a terminal bull market. They are moderately operated and decrease their correlation with the equity market until they are sure to end the bear market. Thus, large funds become more cautious and do not aim to participate in gains during an upward market. On the protective side, funds still keep high links in a bad market condition, but gradually reduce correlation over time. The hedge funds decrease the correlation whether the market condition is good or bad. Although the results fall short of our expectations, a tendency to improve the protective effect is very evident. However, it may interpret that in order to survive, the funds become to value the downside protection. If the funds can not provide better protection, they will be eliminated due to the pressure of competition.

Nevertheless, this has raised the tendency towards risk management by lessening the correlations with a falling market. Generally, this supports the statement that hedge funds participate in partial upside gains and preserve downside protection under general market conditions, but that hedge funds abandon upside gains in the terminal bull market to reduce the reversal loss. It also implies that hedge funds seem to raise their tendency of risk control to match investors' demand.

**(2). Downside Protection under extreme market condition**

We also are interested to know how hedge funds perform when financial markets are extremely volatile or reacted. Can they preserve their protective function to defend against financial shocks? We grouped five scenarios of the US equity by sorting descending monthly returns of the S&P 500 index between 1994 and 2004. Scenario 1 consisted of the worst months for US equity, and reflected the extreme pessimism and worry about shocks of financial events. Scenario 5 consisted of the best months for US equity, and reflected the over optimistic view of the market's outlook or the rebound after the sharp fall. Scenarios 2, 3 and 4 could be regarded as being separately pessimistic, fair and optimistic for the equity market outlook. We calculated the correlations, the average monthly returns of the S&P500 and the responding portfolios of the hedge fund for each scenario. We also used a t-test for group comparison between the CS/Tremont sub-sector indices and the sectoral portfolios of the TASS sample for each scenario. The resultst demonstrate that there is no significant difference of mean returns between both, but the group variances are significantly unequal for some categories[29], while the variances of the CS/Tremont sub-sector indices are higher than the TASS sample. Table 13 displays descriptive statistics of the monthly return and the correlation with US equity under each scenario. Panels A and B show the results of the CS/Tremont sub-sector indices and sectoral portfolios of the TASS sample.

The signs and coefficients of the correlation of both are similar. In addition, most of the variances and performances of the CS/Tremont sub-sector indices are higher than the TASS sample. In terms of the hedge fund industry, this illustrates a significantly positive correlation with the S&P500 index and the portfolio of the TASS sample, the coefficient of which is 0.54 at $\alpha$=1%, since the equity market is extremely pessimistic. However, the coefficient of the correlation is 0.29 and is not significant for the CS/Tremont composite index. When the equity market is hot, the coefficients of the TASS sample and the CS/Tremont composite index are -0.29, -0.37, and only the latter is significant at $\alpha$=10%.[30] In contrast with the statistics of the performance, the asset-weight portfolio of the TASS sample provides lower and more stable returns than the CS/Tremont index for each scenario. Of course, they experience fewer losses as the market crashes, and there is a relatively small range of maximum losses and gains among each scenario. This may imply that the representative funds with large AUM tend to trade more aggressively under the principle of low links with the market, and enforce stopping gains when the market appears to be over-optimistic. Furthermore, we also observe that most categories of hedge funds have a significantly positive

[29] We only show the significant part and the other details refer to the appendix table A3.
[30] The other similar cases include the Equity market neutral and Fixed income arbitrage that the significantly coefficients of both for the TASS sample are 0.45, 0.37 in scenario 1 and not significant for CS/Tremont index.

correlation with the US equity market in Scenario1 and an uncorrelated or negative correlation in Scenario 5. Only Short bias and Managed futures are all negatively correlated in extreme market conditions. Briefly, the performance of most hedge funds is, indeed, affected, and this reflects tail risks as the financial market faces great shocks or extreme pessimism. Also, most funds do not aim to chase gains during an extremely optimistic market, but rather stop profit to achieve target returns.

Figure 18 exhibits the payoff of an asset-weight portfolio for the sectoral TASS sample vs. the S&P500 index in the five scenarios. The level of mean and median is similar, and the gap of both only becomes large in extreme conditions, such as scenario 1. We divide two classes of funds and analyze their effect on protection according to the level of the previous 36-months rolling correlation.

(A) A high correlation with the US equity market, such as the Emerging market, Long/short equity, Multi-strategy, Event driven, Fund of funds and Short bias.

Overall, the payoffs for the funds gradually ascend as market conditions improve, except for Short bias. Although the degree of losses for hedge funds is below the benchmark, their average (or median level) returns are still negative when the equity market suffers from great shocks or recession. The statistics of maximum losses for each scenario indicate that the maximum loss in Scenario 1 is almost 2-3 times as much as in the others. Hence, the hedge funds are still undergoing the tail risks in an extremely volatile financial market. Compared with an extremely optimistic market, some categories of hedge funds in the TASS sample, such as event driven and multi-strategy, are lower returns than they were in optimistic conditions (i.e. Scenario 4). This may imply that these funds prefer to maintain steady returns in a hot market and reserve some unrealized profits in order to cushion the effect of a crash in the future. Of course, the required conditions, in which smoothing profits can work, are able to hold the portfolios of some illiquid securities. According to Lo (2004) the event driven funds are highly serially correlated and have a lower smoothing index than other categories with liquidity.

However, in the case of the other CS/Tremont sub-index or other categories of TASS sample experience increasing returns as the market condition improves. Also, there is not too great a difference between the maximum gains and average returns of Scenarios 4 and 5, although the coefficient of the correlation is only negative in Scenario 5. This phenomenon, in which the maximum monthly gains or average rewards are not as large as the degree of the increase in the equity market, may be interpreted to mean that the

majority of large hedge funds make partial gains in a bull market, but control risk exposure by means of stopping gains in extremely optimistic conditions.

(B) .Low correlation with the US equity market, such as Convertible arbitrage, Equity neutral, Fixed income arbitrage, Global macro, and Managed futures. The levels of mean and median are close and we simply divide three patterns on the basis of their payoffs.

(i). the payoff is slightly increased as the market condition improves, for example Equity market neutral, Global macro.

There are significantly negative correlations for the Global macro of the TASS sample in Scenarios 2 and 5, but only significantly positive correlations in Scenario 3 for the CS/Tremont index. The other scenarios show a low correlation with the equity market for Global macro. If we further observe their range of maximum gain, loss or median return for each Scenario, the TASS sample seems to underperform and suffer less exposure than the CS/Tremont index. It is interesting to note that the maximum monthly loss of the Global macro funds (i.e. the CS/Tremont index –11.55%, the TASS sample -4.87%) occurred in Scenario 5, but the maximum monthly gain occurred in Scenario 2 (i.e. the CS/Tremont index 10.60%, the TASS sample 10.02%). In general, the funds of the Macro bear temporary losses to exploit the profit opportunities during a hot equity market when they perceive the existence of economic bubbles. Their gains are reflected in market modification if they predict correctly. Due to the advantage of solid capital to absorb the cost of wrong judgment, large funds can take more aggressive action than small and medium funds. For example, they can first take a strategy of riding the bubbles and then attacking them, so that their performance is better and has a less negative correlation with the equity market than small and medium funds in an extremely hot market. In other words, most US medium funds[31] trade more safely to maintain equivalent rewards in the asset market. If they take a more aggressive or contrarian-trading strategy, they need to bear the loss of a short squeeze and underperform their competitors. Moreover, they have to acquire the trust of investors to survive until the market modifies. Due to their capital weakness, they have to take the potential risk of withdrawing capital, even when a trading decision is correct in post. Hence, “The less you do the fewer mistakes you make” is probably the best advice. However, in terms of the difference between the CS/Tremont index and the TASS sample for equity market neutral, the latter also underperforms and suffers less exposure than the former. This generally shows only slight variations in maximum gains and

[31] We ignore the effect about small funds because low weights of portfolio is affected even they take more aggressive or risky trading

losses among the scenarios, although market conditions may be extremely volatile or reactive. This may be the result of smoothing returns[32] and neutralizing market exposure as a strategic goal. Thus, the performance of these kinds of funds are slightly affected by an extreme equity market crash.

(ii). The payoff shows an inverse U-shaped as equity market conditions improve, for example, Fixed income arbitrage.

The performance of fixed income arbitrage funds is at its poorest when the equity market is extremely hot or depressed, and keeps steady returns in other states. This is consistent with the Fung & Hsieh (1999) version of fixed income arbitrage funds performing best in clam markets and worst in volatile markets. They take short volatility trading strategy to acquire stable profits in a clam market. Thus, their protective effect is not obvious as the equity market crashes.

(iii). the payoff shows a similar U-shape and W-shape, for example, Convertible arbitrage, Managed futures.

Convertible arbitrage funds performed the poorest in a clam market but steadily and well under other market conditions. This shows a close U-shaped payoff, which is similar to a long straddle or strangle option, and displays the protective value in an extremely volatile market. In contrast with the trend of equity market volatility, which began to reduce from 2002, the performance of CB funds also suddenly dropped at the same time. This seems to verify that they used a long volatility trading strategy to gain protective values. Managed futures showed a likely W-shape payoff, which can be achieved by combining one straddle option with a low strike price and two bullish spreads with a medium and high strike price. This means that funds can make more money if the price moves out of the desired range. In other words, it obtains large profits during extreme market conditions and losses if the price stays within a specific range. This is also consistent with the findings of Fung & Hsieh (1999) and Edwards & Caglay (2001) that, when following the trend, CTAs or commodity funds provide better downside protection during bear equity than other hedge funds. Thus, these kinds of funds do indeed provide good protection during the worse downturns, and may be appropriately invested as portfolio insurance.

[32] According to Lo (2004) study show that funds of Convertible arbitrage, Equity neutral, Fixed income arbitrage tend to be highly serially correlated and lower smoothing index than other categories with liquidity.

## 5. Conclusion

This paper provides some evidence about the development of the hedge fund industry over the past decade, focusing on the change in the composition of investors, preference for risk and reward, and the degree of competition in the industry. Several conclusions have been reached, and these are discussed in the following paragraphs.

### Change in the composition of investors, preference for risk and reward

The change in the structure of the investors resulted in the fact that the risk preference of the industry tended to be more conservative and safe. The required returns and maximum loss for bearing are also stricter than before, leading to a mainstream style of strategy for each lifecycle. The relevant results are outlined below.

Firstly, the change in the composition of investors, which obviously shifted from high–net-wealth individuals to institutions, drove the alteration of the main investment style and the requirements for risk and reward. From the demands of investors, the trend of the allocated strategy was that the major types shifted from directional betting to non-directional or a hybrid style of both gradually provided balance and diversification.

Secondly, the performance of the hedge funds industry was volatile, the same as it had been in the equity market in the 1990s, but then the volatility decreased fast, and volatility spread was expanded after the year 2000. Investors tended to execute a demand for low volatility by their choice of investment strategy. Fund managers were unable to use risky trading to earn promised profits like they could before and even the traditional asset market was less fluctuant. Besides, the behavior of investors had changed for required returns and the degree of undertaking loss. Investors were becoming more rigorous for required returns and less patient than before for undertaking loss. If the funds could not offer the promised performance, investors would rather withdraw their capital, even in poor market conditions, than wait longer to verify performance.

Thirdly, Esterling (2007) indicates that different scale funds develop different business models to survive in their marketing segmentation due to the driving force of institutional investors. Under the M-shaped trend of asset scales in the hedge funds industry, large fund managers have sufficient capability and capital to attract talent and develop complex trading models and risk mechanisms. Due to the above advantages, large funds can take more aggressive and complex actions than small and medium funds, especially in extreme market conditions. We find that the pattern of performance for

large funds is more volatile, outperforms others, and has less correlation with the equity market in extremely pessimistic cases. However, it has a significantly negative correlation in extremely optimistic conditions. In terms of most US medium funds, they adopt safer trading to maintain rewards equivalent to the asset market.

**Change of degree of competition in the industry**

Is the competitive environment of the hedge fund industry fiercer? Are the survival conditions stricter than before due to increasing financial market uncertainty and competition? The following results appear to reflect more competition and difficultly for young funds to survive.

Firstly, competition in the hedge funds industry has risen slightly over time, in line with the trend to increase the overall attrition rate. However, the trend for each strategy shows an obvious cycle over time, and peaks are concentrated in two periods, namely 1997-1998 and 2000-2001. If we combine the dynamic pattern of the attrition rate, dollar flows, entrants and performance of each strategy at the same time, we find that the degree of sub-industrial competition is affected by the transfer preference of investors in the sub-industries. After intense competition and market trail, favorable sub-industries generally began to weed out the marginal funds which were suffering from loss and income deficit. Since following their attrition rate and outflows achieved peaks, and then reversed to the original normal level, only the fittest funds could survive during elimination. The dynamic competition effect for hedge funds across each strategy affected the survival of funds and, indeed, the main strategies of hedge funds also varied in the face of competition and market conditions.

Secondly, we find an upward trend of defunct ratios and a downward trend of survival time for young funds. It is more difficult than before for young funds to survive and they need to achieve a survival threshold by shortening the time for beating competitors. This implies that the industrial environment competes more and more, and that the possibility of early termination increases if young funds perform badly.

Thirdly, the profit-making space of hedge funds is being gradually compressed due to the change in the competitive environment. The alpha trend peaked in the first quarter of 2000, after which we observed the downward pattern of the alpha with the cycle lasting until the second quarter of 2003. By weeding-out the competition, the excess returns of the overall hedge funds rebounded in 2003, and then turned down slowly.

Fourthly, the pattern of the protective effect over time does not match our expectation.

The overall hedge funds abandoned upside gains in the terminal bull market to reduce the reversal loss, and seemed to raise a tendency towards risk control. The hedge funds decrease the correlation whether the market condition is good or bad. Although the results fall short of our expectations, a tendency to improve the protective effect is very evident. It means that in order to survive, the funds become to value the downside protection. If the funds can not provide better protection, they will be eliminated due to the pressure of competition. In general, the overall hedge funds care about risk control during a bull market and give up some potential gains in order to reduce loss during the oncoming crash. This means that the one of objectives of hedge funds is to keep a stable range of returns, volatility and correlation under each market scenario.

Fifthly, in extreme market conditions, the performance of most hedge funds was indeed hurt, and this reflected tail risks as the financial markets faced great shocks and/or extreme pessimism. However, many funds do not aim to chase gains during an extremely optimistic market, but rather stop profit to achieve their target returns. Especially representative funds with large AUM more obviously tend to reduce the downward shock by adopting the principle of low links with the market and enforcing stopping gains when the market appears to be over-optimistic. Nevertheless, this has raised a tendency towards risk management as lessening the correlations within a falling market.

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Figure 1: Trend of the last 12-month return for individual defunct funds before exit

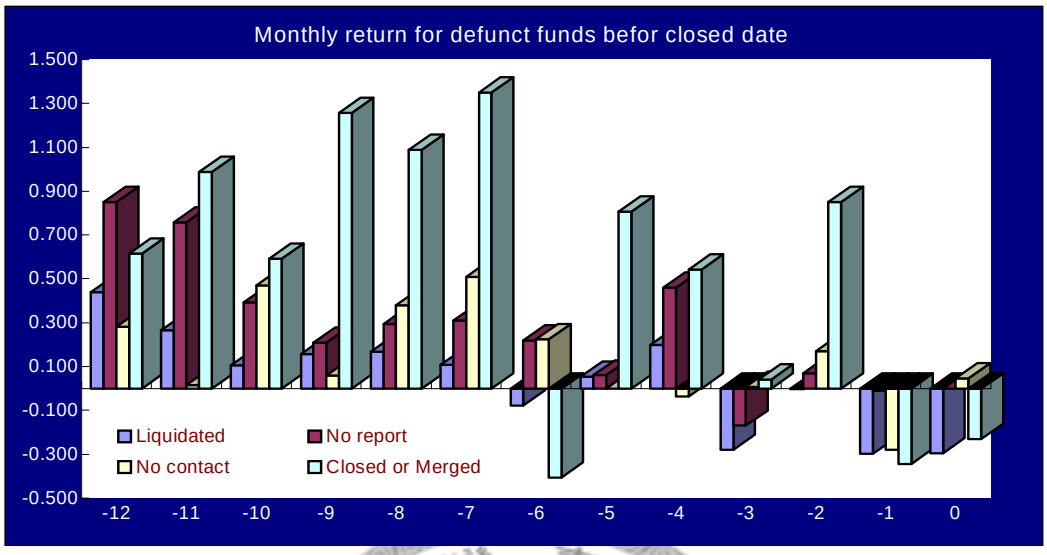
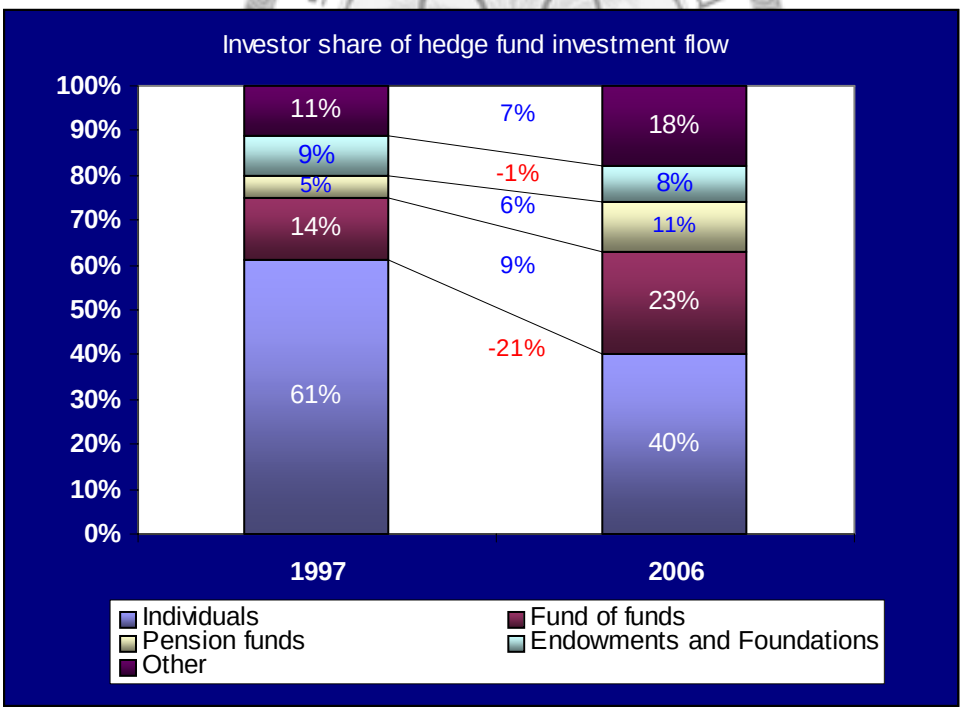



Figure 2: Comparison of investor's share of hedge fund investment flow between 1997 and 2006.




Data source: Credit Suisse hedge fund overview on December 2007, which points to the Hennessee Group LLC as being the original source.

Table 1: Basic statistics for empirical sample

Panel A: Number of live funds and exited funds for each investment style

| Sample size | All | percent % | Live | percent % | Defunct | percent % | Liquidated | No report | No contact | Closed or Merged |
|---|---|---|---|---|---|---|---|---|---|---|
| Convertible Arbitrage | 140 | 5.6% | 105 | 75% | 35 | 25% | 15 | 12 | 5 | 3 |
| Dedicated Short Bias | 21 | 0.8% | 11 | 52% | 10 | 48% | 5 | 3 | 1 | 1 |
| Emerging Markets | 205 | 8.1% | 99 | 48% | 106 | 52% | 65 | 24 | 13 | 4 |
| Equity Market Neutral | 185 | 7.3% | 100 | 54% | 85 | 46% | 63 | 13 | 8 | 1 |
| Event Driven | 274 | 10.9% | 177 | 65% | 97 | 35% | 46 | 35 | 13 | 3 |
| Fixed Income Arbitrage | 144 | 5.7% | 90 | 63% | 54 | 38% | 25 | 20 | 5 | 4 |
| Global Macro | 151 | 6.0% | 86 | 57% | 65 | 43% | 33 | 18 | 13 | 1 |
| Long/Short Equity Hedge | 1008 | 40.0% | 580 | 58% | 428 | 42% | 209 | 164 | 46 | 9 |
| Managed Futures | 282 | 11.2% | 111 | 39% | 171 | 61% | 108 | 23 | 34 | 6 |
| Multi-strategy | 108 | 4.3% | 73 | 68% | 35 | 32% | 25 | 7 | 2 | 1 |
| Individual Funds | 2518 | 100% | 1432 | | 1086 | | 594 | 319 | 140 | 33 |
| Fund of Funds | 577 | | 394 | | 183 | | 95 | 62 | 20 | 6 |

Note: TASS gives seven statuses for funds that are transferred to graveyard database. Status 1 is fund liquidated (i.e. Liquidated). Status 2 is fund no longer reporting to TASS (i.e. No report). Status 3 is that TASS has been unable to contact the manager for updated information (i.e. No contact). Status 4 is funds closed to new investment. (i.e. Closed or Merged). Status 5 is fund has merged into another entity. (i.e.Closed or Merged) Status 6 is funds dormant and status 7 is unknown. We regard status 6 and status 7 as status3.

Panel B: Live funds and exited funds with the mean and median of average monthly returns, volatility, Maximal monthly gain, Maximal monthly loss, and assets under management (AUM). Average monthly returns, volatility, average AUM are calculated for each fund during their duration.

| Individual funds | Number of funds | Average monthly return % | | Standard deviation of monthly return % | | Maxium of monthly return % | | Mimium of monthly return % | | Average monthly AUM (US thousand) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | mean | median | mean | median | mean | median | mean | median | mean | median |
| Live | 1432 | 1.09 | 0.94 | 3.68 | 2.76 | 12.38 | 8.09 | -8.73 | -5.69 | 88,952 | 38,627 |
| Liquidated | 594 | 0.35 | 0.42 | 5.29 | 3.88 | 14.44 | 9.18 | -12.47 | -8.94 | 29,634 | 10,377 |
| No report | 319 | 1.00 | 0.84 | 6.31 | 4.98 | 18.03 | 13.40 | -15.30 | -11.72 | 52,814 | 15,835 |
| No contact | 140 | 0.83 | 0.83 | 6.68 | 4.71 | 18.32 | 12.24 | -15.34 | -11.53 | 16,838 | 7,976 |
| Closed or Merged | 33 | 0.78 | 0.74 | 4.72 | 3.69 | 12.01 | 8.94 | -13.43 | -8.78 | 34,177 | 13,378 |

| Fund of funds | Number of funds | Average monthly return % | | Standard deviation of monthly return % | | Maxium of monthly return % | | Mimium of monthly return % | | Average monthly AUM (US thousand) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | mean | median | mean | median | mean | median | mean | median | mean | median |
| Live | 394 | 0.68 | 0.61 | 1.72 | 1.33 | 5.50 | 3.74 | -4.13 | -2.79 | 83,053 | 36,815 |
| Liquidated | 95 | 0.22 | 0.23 | 3.95 | 3.07 | 9.65 | 6.33 | -10.57 | -7.84 | 20,672 | 9,153 |
| No report | 62 | 0.58 | 0.58 | 3.34 | 2.51 | 9.33 | 6.54 | -9.10 | -6.86 | 46,773 | 19,107 |
| No contact | 20 | 0.39 | 0.41 | 3.66 | 3.63 | 10.22 | 9.13 | -9.50 | -8.00 | 7,130 | 4,393 |
| Closed or Merged | 6 | 0.77 | 0.85 | 6.46 | 6.86 | 19.89 | 19.92 | -14.26 | -14.56 | 18,802 | 3,214 |

Panel C: monthly return and AUM for defunct funds over the last 12 months before exit.

| Individual fund Last12 month before exit | Monthly return % (median) | | | | Monthly AUM (median) US thousand | | | |
|---|---|---|---|---|---|---|---|---|
| | Liquidated | No report | No contact | Closed or Merged | Liquidated | No report | No contact | Closed or Merged |
| -12 | 0.440 | 0.850 | 0.282 | 0.615 | 9,660 | 16,255 | 9,183 | 13,247 |
| -11 | 0.264 | 0.756 | 0.015 | 0.988 | 9,847 | 15,712 | 8,548 | 13,215 |
| -10 | 0.106 | 0.392 | 0.471 | 0.592 | 9,275 | 16,491 | 8,045 | 11,000 |
| -9 | 0.158 | 0.210 | 0.059 | 1.257 | 9,226 | 16,500 | 7,921 | 11,000 |
| -8 | 0.168 | 0.293 | 0.379 | 1.088 | 9,155 | 15,927 | 7,839 | 11,300 |
| -7 | 0.108 | 0.310 | 0.508 | 1.351 | 8,723 | 15,511 | 7,562 | 12,711 |
| -6 | -0.078 | 0.220 | 0.225 | -0.408 | 8,974 | 15,381 | 7,295 | 12,779 |
| -5 | 0.053 | 0.060 | 0.000 | 0.805 | 9,006 | 15,193 | 7,250 | 11,794 |
| -4 | 0.198 | 0.460 | -0.037 | 0.542 | 8,600 | 14,986 | 6,780 | 11,858 |
| -3 | -0.281 | -0.170 | 0.006 | 0.040 | 7,741 | 15,500 | 6,555 | 11,700 |
| -2 | -0.004 | 0.070 | 0.170 | 0.852 | 7,250 | 14,700 | 5,764 | 10,880 |
| -1 | -0.298 | -0.010 | -0.281 | -0.344 | 6,644 | 14,290 | 5,834 | 9,568 |
| 0 | -0.295 | 0.000 | 0.047 | -0.230 | 5,870 | 13,900 | 5,272 | 9,600 |

| Fund of Funds Last12 month before exit | Monthly return % (median) | | | | Monthly AUM (median) | | | |
|---|---|---|---|---|---|---|---|---|
| | Liquidated | No report | No contact | Closed or Merged | Liquidated | No report | No contact | Closed or Merged |
| -12 | -0.180 | 0.087 | 1.230 | -5.941 | 7,986 | 20,200 | 4,954 | 4,000 |
| -11 | 0.000 | 0.778 | 0.673 | -3.883 | 6,931 | 21,000 | 3,899 | 3,825 |
| -10 | 0.234 | 0.404 | -0.775 | 3.550 | 5,885 | 21,000 | 3,971 | 4,035 |
| -9 | 0.150 | 0.134 | -0.316 | -3.966 | 7,082 | 21,000 | 3,954 | 4,075 |
| -8 | 0.116 | 0.580 | -2.117 | -0.935 | 5,849 | 21,980 | 3,844 | 3,545 |
| -7 | 0.390 | 0.540 | 0.795 | -4.808 | 5,848 | 22,000 | 4,345 | 3,300 |
| -6 | 0.597 | 0.000 | 0.311 | -2.746 | 5,874 | 22,215 | 4,383 | 3,293 |
| -5 | 0.000 | -0.208 | -0.367 | -2.037 | 5,899 | 18,860 | 4,479 | 3,065 |
| -4 | 0.532 | -0.475 | -0.555 | -1.923 | 5,906 | 16,235 | 4,545 | 3,000 |
| -3 | -0.008 | 0.190 | 0.396 | 1.960 | 5,900 | 15,773 | 4,962 | 2,695 |
| -2 | 0.205 | 0.116 | -0.260 | -2.575 | 5,600 | 15,734 | 5,084 | 2,568 |
| -1 | 0.030 | 0.130 | 0.642 | -4.255 | 5,449 | 15,386 | 5,272 | 2,440 |
| 0 | 0.240 | 0.109 | -0.201 | 0.546 | 4,918 | 14,373 | 3,654 | 2,407 |

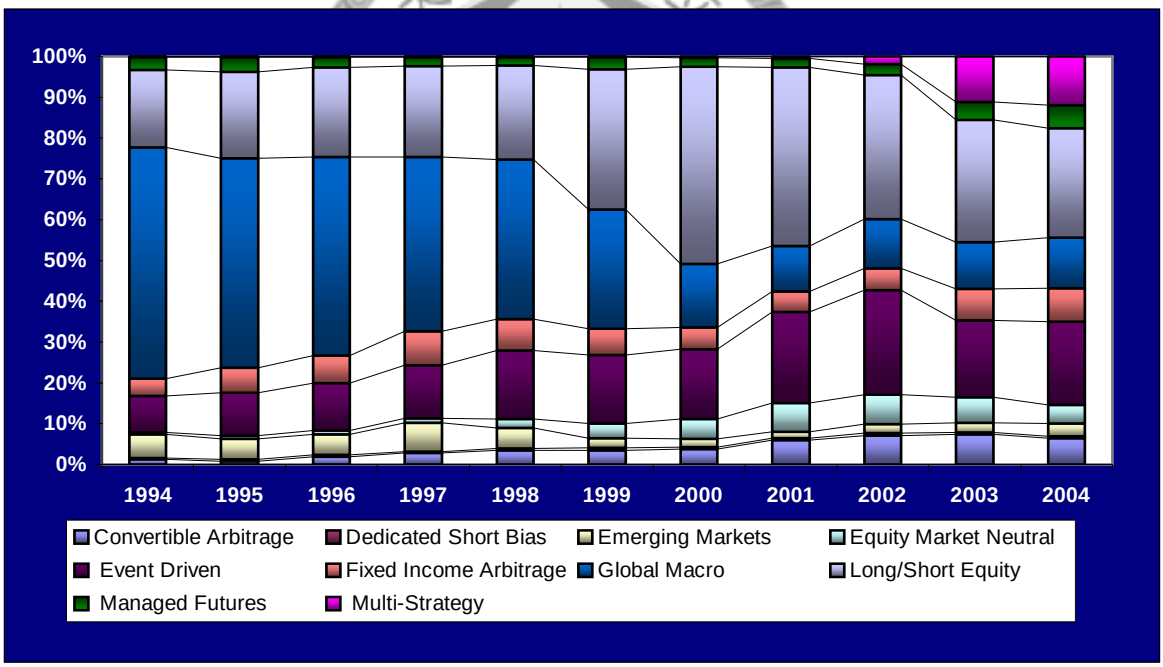
Note: Mean level is easily affected by extreme value and so we observed the pattern of the median

Table2: Sector weights of the Credit Suisse/Tremont hedge funds index (1994-2004)

| Hedge Fund Index -sector | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Convertible Arbitrage | 1.2% | 0.9% | 1.9% | 2.8% | 3.5% | 3.5% | 3.7% | 6.0% | 7.1% | 7.4% | 6.4% |
| Dedicated Short Bias | 0.4% | 0.4% | 0.4% | 0.4% | 0.5% | 0.6% | 0.5% | 0.4% | 0.7% | 0.6% | 0.5% |
| Emerging Markets | 5.7% | 5.0% | 5.1% | 7.1% | 5.0% | 2.4% | 2.0% | 1.7% | 2.1% | 2.2% | 3.1% |
| Equity Market Neutral | 0.5% | 0.9% | 0.9% | 1.1% | 2.2% | 3.6% | 4.9% | 7.0% | 7.3% | 6.3% | 4.6% |
| Event Driven | 9.0% | 10.4% | 11.7% | 13.1% | 16.8% | 16.8% | 17.1% | 22.3% | 25.6% | 18.9% | 20.4% |
| Fixed Income Arbitrage | 4.2% | 6.2% | 6.7% | 8.3% | 7.7% | 6.4% | 5.3% | 5.0% | 5.3% | 7.7% | 8.0% |
| Global Macro | 56.7% | 51.4% | 48.7% | 42.7% | 39.1% | 29.2% | 15.6% | 11.2% | 12.0% | 11.5% | 12.5% |
| Long/Short Equity | 19.0% | 21.2% | 22.0% | 22.2% | 23.1% | 34.4% | 48.3% | 43.8% | 35.4% | 29.9% | 26.8% |
| Managed Futures | 3.2% | 3.6% | 2.6% | 2.3% | 2.1% | 3.0% | 2.2% | 2.2% | 2.6% | 4.4% | 5.6% |
| Multi-Strategy | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.3% | 0.5% | 1.9% | 11.2% | 12.0% |

Data source: Credit Suisse /Tremont website. http://www.hedgeindex.com

Figure 3: Trend of sector weights of the Credit Suisse/Tremont hedge funds index (1994-2004)



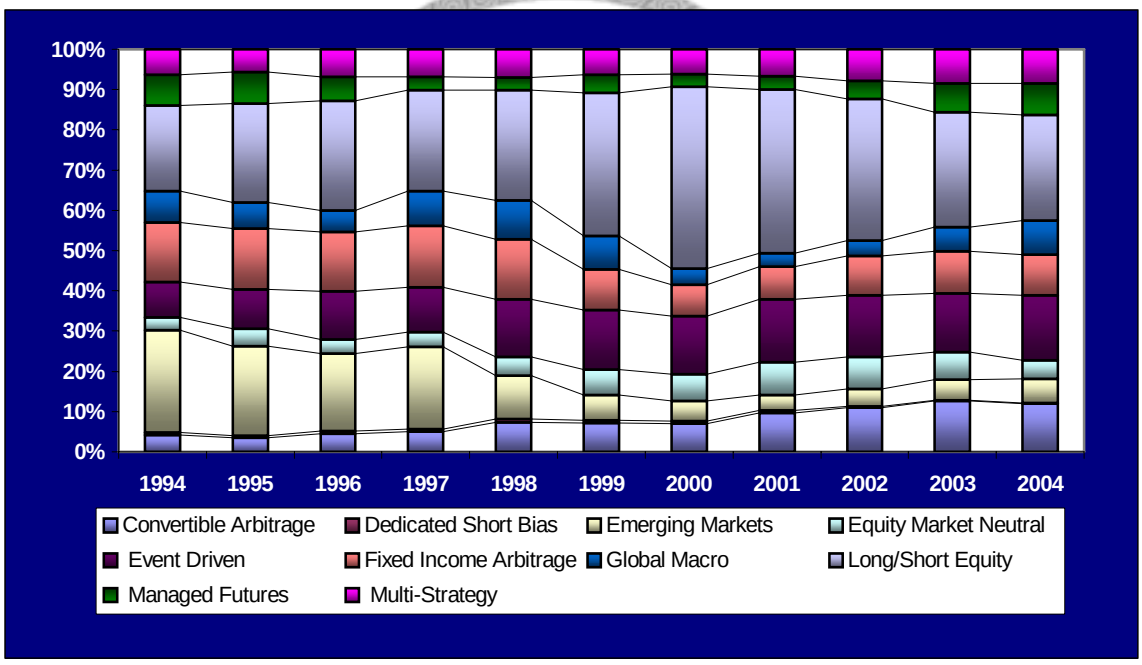

Data source: Credit Suisse /Tremont website. http://www.hedgeindex.com

Table3: Sector weights of the composite portfolio by the TASS sample (1994-2004)

| Hedge Fund Index -sector | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Convertible Arbitrage | 4.2% | 3.4% | 4.5% | 5.0% | 7.3% | 7.1% | 6.9% | 9.7% | 11.0% | 12.6% | 12.0% |
| Dedicated Short Bias | 0.6% | 0.6% | 0.5% | 0.6% | 0.8% | 0.8% | 0.7% | 0.5% | 0.3% | 0.2% | 0.1% |
| Emerging Markets | 25.5% | 22.2% | 19.4% | 20.4% | 10.8% | 6.2% | 5.0% | 3.8% | 4.4% | 5.1% | 5.9% |
| Equity Market Neutral | 3.1% | 4.3% | 3.5% | 3.7% | 4.6% | 6.4% | 6.7% | 8.3% | 7.9% | 6.8% | 4.7% |
| Event Driven | 8.8% | 9.9% | 11.9% | 11.1% | 14.4% | 14.8% | 14.4% | 15.5% | 15.4% | 14.7% | 16.0% |
| Fixed Income Arbitrage | 14.8% | 15.0% | 14.7% | 15.3% | 14.9% | 10.1% | 7.8% | 8.2% | 9.8% | 10.5% | 10.3% |
| Global Macro | 7.8% | 6.5% | 5.2% | 8.6% | 9.7% | 8.3% | 4.0% | 3.2% | 3.8% | 6.0% | 8.4% |
| Long/Short Equity | 21.2% | 24.6% | 27.3% | 25.2% | 27.3% | 35.5% | 45.2% | 40.8% | 35.2% | 28.5% | 26.2% |
| Managed Futures | 7.7% | 7.8% | 5.9% | 3.2% | 3.2% | 4.4% | 3.2% | 3.4% | 4.5% | 7.2% | 7.8% |
| Multi-Strategy | 6.2% | 5.6% | 6.9% | 6.8% | 7.0% | 6.4% | 6.2% | 6.6% | 7.8% | 8.4% | 8.5% |

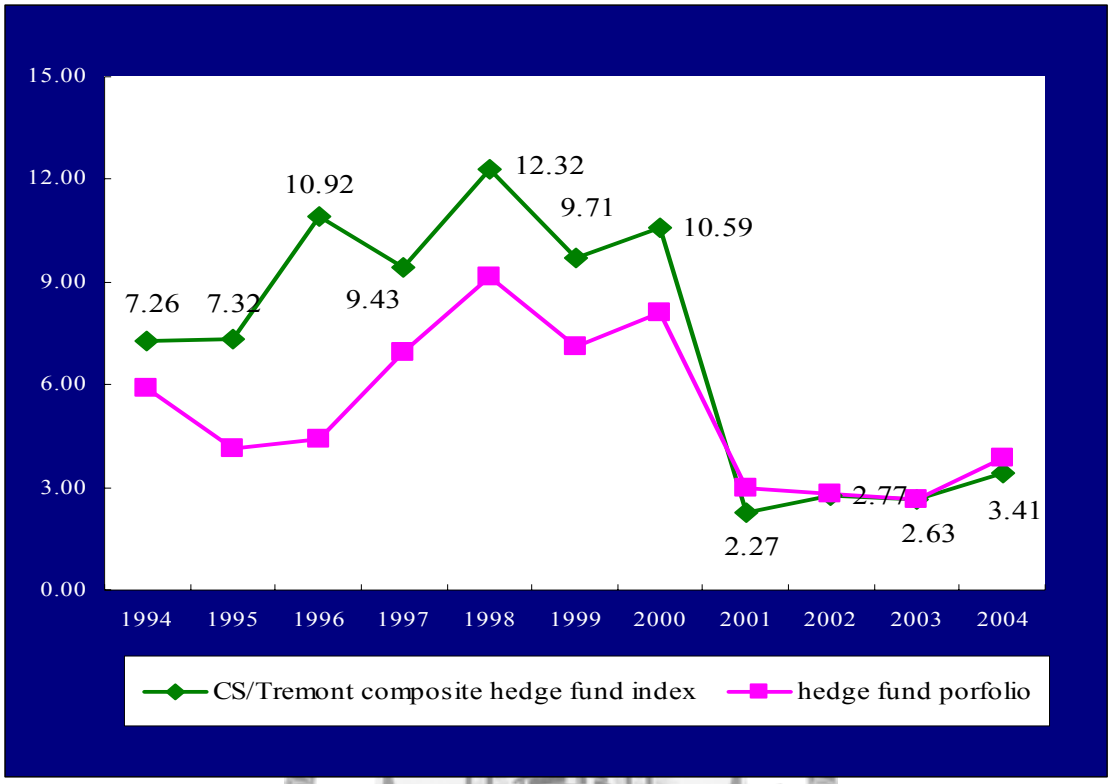
Data source: TASS database

Figure 4: Trend of Sector weights of the composite portfolio by the TASS sample (1994-2004)



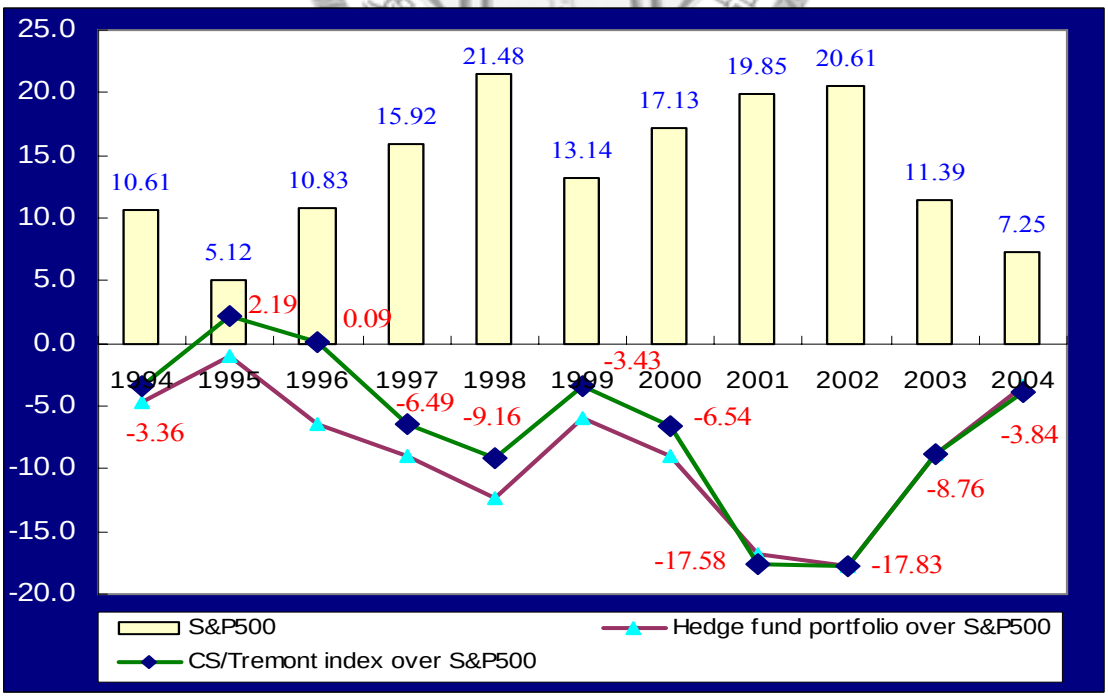

Data source: TASS database

Figure 5: Time series trend of the volatility based on the CS/Tremon composite index and asset-weight portfolio (1994-2004)




Data source: TASS database

Figure 6: Trend of volatility spread between hedge funds and S&P 500



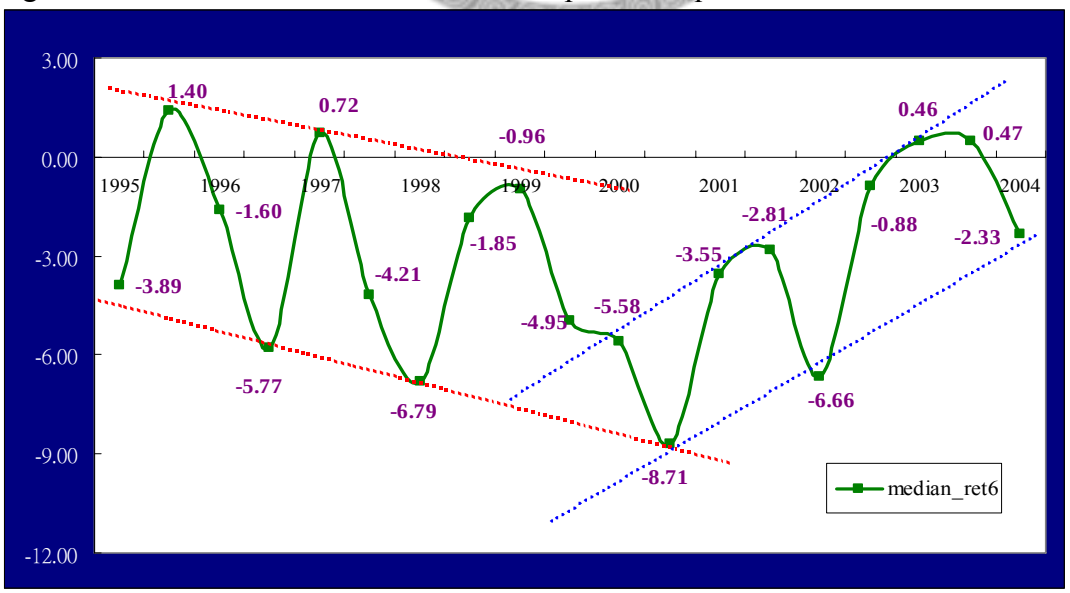

Data source: TASS database

Table 4. 6-month buy and hold return of liquidated funds prior to liquidation time in comparison with the CS/Tremont index between 1994 and 2004

| Exit Year Individual liquidated | Number of funds | 6 month Buy & Hold return % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Absolute return | | Excess return | | CS/Tremont index | Difference 1 |
| | | mean | median | mean | median | | |
| 1994Q3-Q4 | 2 | -15.38 | -15.38 | -18.77 | -18.77 | 2.62 | -18.00 |
| 1995Q1-Q2 | 2 | -7.68 | -7.68 | -14.18 | -14.18 | 4.81 | -12.49 |
| 1995Q3-Q4 | 11 | -12.81 | -3.89 | -9.40 | -1.43 | 16.10 | -19.99 |
| 1996Q1-Q2 | 9 | -5.90 | 1.40 | -11.26 | -10.05 | 11.45 | -10.05 |
| 1996Q3-Q4 | 13 | -3.44 | -1.60 | -9.53 | -5.50 | 9.67 | -11.27 |
| 1997Q1-Q2 | 19 | -11.70 | -5.77 | -23.65 | -18.80 | 11.78 | -17.55 |
| 1997Q3-Q4 | 10 | -2.33 | 0.72 | -10.53 | -15.53 | 12.67 | -11.94 |
| 1998Q1-Q2 | 30 | -5.61 | -4.21 | -9.71 | -8.37 | 9.72 | -13.93 |
| 1998Q3-Q4 | 42 | -11.44 | -6.79 | -11.93 | -14.60 | -9.19 | 2.40 |
| 1999Q1-Q2 | 13 | -3.26 | -1.85 | -10.70 | -9.79 | 6.87 | -8.72 |
| 1999Q3-Q4 | 49 | -1.25 | -0.96 | -9.37 | -9.53 | 15.49 | -16.45 |
| 2000Q1-Q2 | 36 | -10.87 | -4.95 | -21.03 | -18.88 | 1.75 | -6.70 |
| 2000Q3-Q4 | 23 | -11.54 | -5.58 | -12.72 | -8.82 | 3.05 | -8.63 |
| 2001Q1-Q2 | 21 | -16.98 | -8.71 | -15.08 | -15.79 | 2.13 | -10.84 |
| 2001Q3-Q4 | 46 | -5.68 | -3.55 | -6.40 | -4.19 | 2.24 | -5.80 |
| 2002Q1-Q2 | 37 | -1.97 | -2.81 | -3.75 | -5.30 | 1.34 | -4.15 |
| 2002Q3-Q4 | 61 | -8.48 | -6.66 | -11.16 | -6.82 | 1.69 | -8.34 |
| 2003Q1-Q2 | 42 | 1.01 | -0.88 | -4.26 | -5.90 | 7.94 | -8.82 |
| 2003Q3-Q4 | 57 | 1.72 | 0.46 | -4.85 | -4.66 | 6.95 | -6.49 |
| 2004Q1-Q2 | 42 | 1.19 | 0.47 | -4.64 | -4.77 | 2.93 | -2.46 |
| 2004Q3-Q4 | 29 | -3.10 | -2.33 | -4.52 | -4.89 | 6.52 | -8.85 |

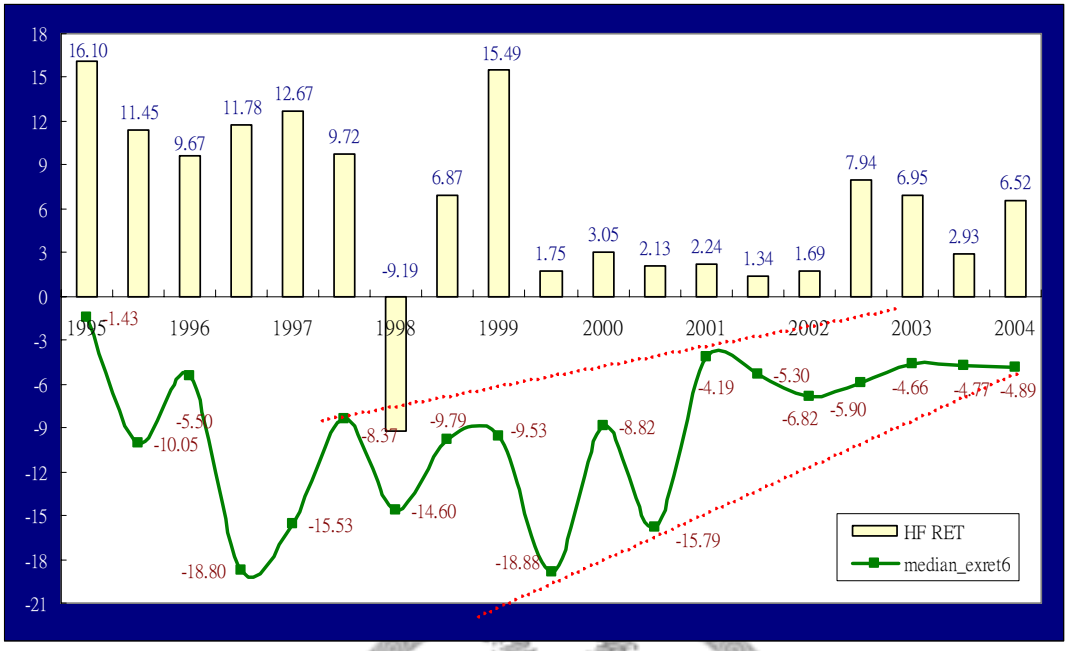
note: 1. Difference1 is the gap between absolute return and CS/Tremont index

Figure 7. Trend of 6-month absolute returns prior to liquidation between 1995 and 2004




Note: Absolute return is defined as buy and hold return and plot median return of each semiannual sample.

Figure 8. Trend of 6-month excess returns prior to liquidation between1994 and 2004




Note: Excess return is defined as fund returns subtract corresponding the CS/Tremont style benchmarks, then plot the median return of each semiannual sample.

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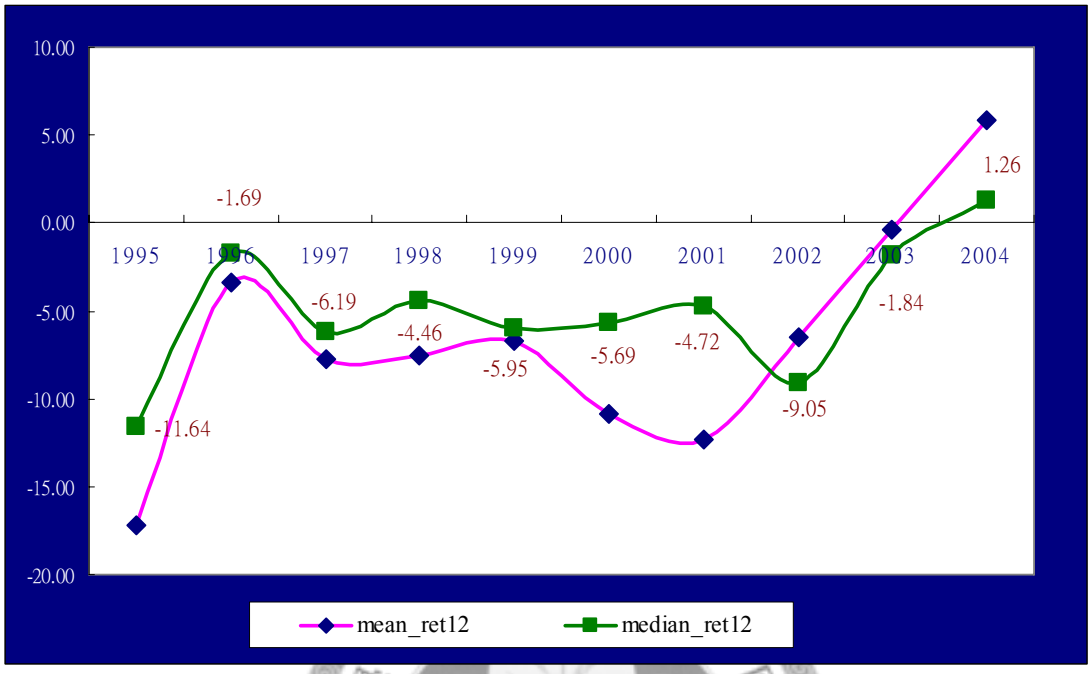
Table 5. 12 month buy and hold return of liquidated funds prior to liquidation time in comparison with the CS/Tremont index between 1994 and 2004

| Exit Year Individual liquidated | Number of funds | 12 month Buy & Hold return % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Absolute return | | Excess return | | CS/Tremont index | Difference 1 |
| | | mean | median | mean | median | | |
| 1994 | 2 | -31.27 | -31.27 | - | - | -4.36 | -26.91 |
| 1995 | 13 | -17.21 | -11.64 | -10.13 | -5.65 | 21.69 | -33.32 |
| 1996 | 22 | -3.36 | -1.69 | -10.24 | -9.45 | 22.22 | -23.91 |
| 1997 | 29 | -7.79 | -6.19 | -19.13 | -20.51 | 25.94 | -32.12 |
| 1998 | 72 | -7.55 | -4.46 | -11.01 | -14.47 | -0.36 | -4.10 |
| 1999 | 62 | -6.73 | -5.95 | -9.65 | -16.04 | 23.43 | -29.38 |
| 2000 | 59 | -10.85 | -5.69 | -17.79 | -18.22 | 4.85 | -10.54 |
| 2001 | 67 | -12.30 | -4.72 | -9.12 | -11.43 | 4.42 | -9.13 |
| 2002 | 98 | -6.55 | -9.05 | -8.36 | -10.89 | 3.04 | -12.10 |
| 2003 | 99 | -0.39 | -1.84 | -4.60 | -10.31 | 15.44 | -17.28 |
| 2004 | 71 | 5.89 | 1.26 | -4.59 | -10.15 | 9.64 | -8.38 |

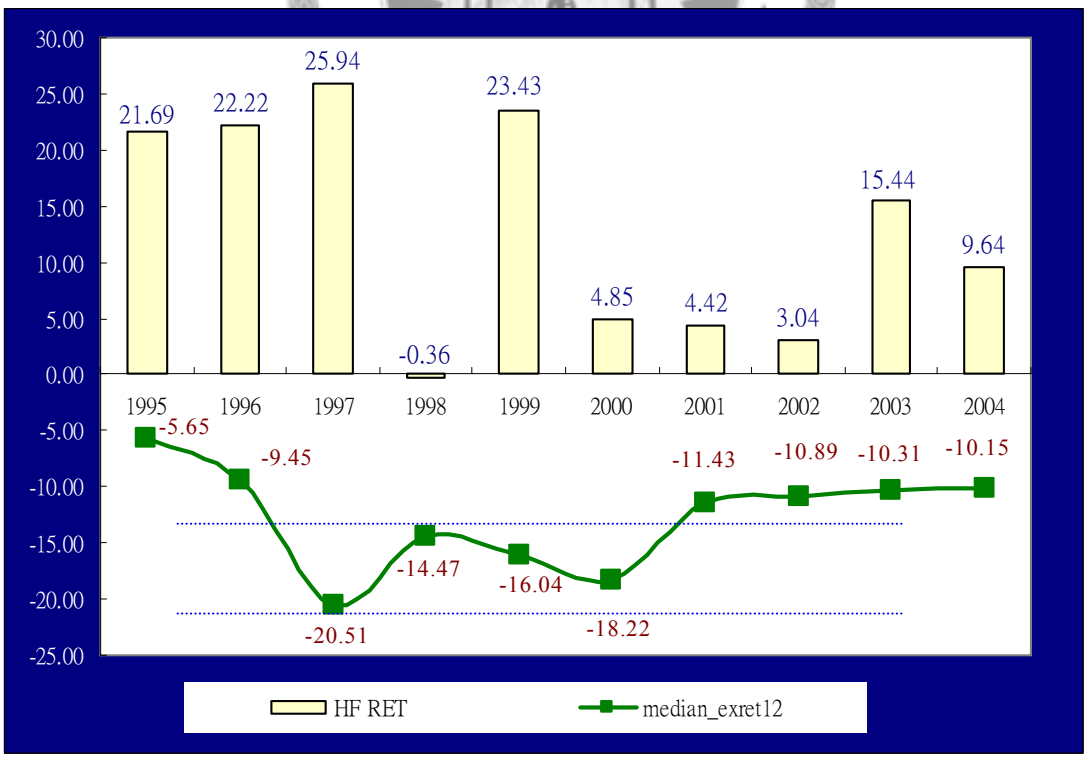
note: 1. Difference1 is the gap between absolute return and CS/Tremont index

Figure 9. Trend of 12-month absolute returns prior to liquidation between 1995 and 2004




Note: Absolute return is defined as buy and hold return and plot median return of each annual sample.

Figure 10. Trend of 12-month excess returns prior to liquidation between 1994 and 2004




Note: Excess return is defined as fund returns subtract the corresponding CS/Tremont style benchmarks, then plot the median return of each annual sample.

Table 6. Numbers and proportion of defunct funds for each exit reason between 1994 and 2004

**Individual funds**

| Exit Year | Total exit | Liquidated | % | No report | % | No contact | % | Closed or merged | % |
|---|---|---|---|---|---|---|---|---|---|
| 1994 | 5 | 2 | 40.00 | | - | 3 | 60.00 | | - |
| 1995 | 16 | 13 | 81.25 | | - | 3 | 18.75 | | - |
| 1996 | 50 | 22 | 44.00 | 4 | 8.00 | 22 | 44.00 | 2 | 4.00 |
| 1997 | 49 | 29 | 59.18 | 9 | 18.37 | 11 | 22.45 | | - |
| 1998 | 94 | 72 | 76.60 | 12 | 12.77 | 8 | 8.51 | 2 | 2.13 |
| 1999 | 109 | 62 | 56.88 | 24 | 22.02 | 15 | 13.76 | 8 | 7.34 |
| 2000 | 140 | 59 | 42.14 | 46 | 32.86 | 28 | 20.00 | 7 | 5.00 |
| 2001 | 165 | 67 | 40.61 | 75 | 45.45 | 20 | 12.12 | 3 | 1.82 |
| 2002 | 183 | 98 | 53.55 | 60 | 32.79 | 21 | 11.48 | 4 | 2.19 |
| 2003 | 164 | 99 | 60.37 | 54 | 32.93 | 6 | 3.66 | 5 | 3.05 |
| 2004 | 111 | 71 | 63.96 | 35 | 31.53 | 3 | 2.70 | 2 | 1.80 |
| Total | 1086 | 594 | 54.70 | 319 | 29.37 | 140 | 12.89 | 33 | 3.04 |

**Fund of funds**

| Exit Year | Total exit | Liquidated | % | No report | % | No contact | % | Closed or merged | % |
|---|---|---|---|---|---|---|---|---|---|
| 1994 | 0 | | | | | | | | |
| 1995 | 6 | 6 | 100 | | - | | - | | - |
| 1996 | 9 | 7 | 77.78 | | - | 2 | 22.22 | | - |
| 1997 | 11 | 8 | 72.73 | | - | 3 | 27.27 | | - |
| 1998 | 15 | 14 | 93.33 | | - | 1 | 6.67 | | - |
| 1999 | 7 | 3 | 42.86 | 2 | 28.57 | 2 | 28.57 | | - |
| 2000 | 23 | 10 | 43.48 | 7 | 30.43 | 5 | 21.74 | 1 | 4.35 |
| 2001 | 36 | 12 | 33.33 | 19 | 52.78 | 2 | 5.56 | 3 | 8.33 |
| 2002 | 22 | 6 | 27.27 | 12 | 54.55 | 2 | 9.09 | 2 | 9.09 |
| 2003 | 33 | 21 | 63.64 | 10 | 30.30 | 2 | 6.06 | | - |
| 2004 | 21 | 8 | 38.10 | 12 | 57.14 | 1 | 4.76 | | - |
| Total | 183 | 95 | 51.91 | 62 | 33.88 | 20 | 10.93 | 6 | 3.28 |

Table 7. Attrition rates and Liquidation rates between 1994 and 2004

Panel A: Attrition rate of individual funds

| Year | Initial numbers | Entry numbers | Exit numbers | Final numbers | Attration Rate % |
|---|---|---|---|---|---|
| 1994 | 136 | 162 | 5 | 293 | 3.68 |
| 1995 | 293 | 212 | 16 | 489 | 5.46 |
| 1996 | 489 | 246 | 50 | 685 | 10.22 |
| 1997 | 685 | 263 | 49 | 899 | 7.15 |
| 1998 | 899 | 232 | 94 | 1037 | 10.46 |
| 1999 | 1037 | 280 | 109 | 1208 | 10.51 |
| 2000 | 1208 | 255 | 140 | 1323 | 11.59 |
| 2001 | 1323 | 268 | 165 | 1426 | 12.47 |
| 2002 | 1426 | 263 | 183 | 1506 | 12.83 |
| 2003 | 1506 | 201 | 164 | 1543 | 10.89 |
| 2004a | 1543 | 0 | 111 | 1432 | 7.19 |
| average | | | | | 9.53 |

Note: The new funds in 2004 are zero due to requiring more than one-year track records for sample funds. And TASS generally have waiting periods before moving no reporting funds form live to graveyard database, so the attrition rate in 2004 has downward bias. The average is calculated from 1994 to 2003 and 2004 data is ignored.

Panel B: Attrition rates for each category

| year | Convertible Arbitrage | Dedicated Short Bias | Emerging Markets | Equity Market Neutral | Event Driven | Fixed Income Arbitrage | Fund of Funds | Global Macro | Long/Short Equity Hedge | Managed Futures | Mulit-strategy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1994 | - | - | - | - | - | 16.67 | - | - | 2.63 | 8.82 | - |
| 1995 | - | - | - | - | - | 5.26 | 8.33 | 5.88 | 2.53 | 16.18 | 6.67 |
| 1996 | 3.33 | - | 4.17 | - | 4.17 | 6.67 | 8.04 | 20.00 | 8.70 | 23.40 | 4.76 |
| 1997 | 5.41 | 14.29 | 6.45 | - | 4.17 | 9.09 | 7.53 | 10.00 | 5.68 | 13.21 | 6.25 |
| 1998 | 9.09 | - | 18.18 | 2.63 | 2.11 | 14.81 | 8.29 | 7.69 | 8.46 | 16.80 | 11.90 |
| 1999 | 5.66 | 10.00 | 12.93 | 19.05 | 12.07 | 11.48 | 3.17 | 13.64 | 7.33 | 14.29 | 4.55 |
| 2000 | 5.00 | 7.14 | 17.07 | 14.29 | 8.59 | 15.15 | 8.88 | 27.94 | 8.54 | 14.93 | 3.92 |
| 2001 | 5.63 | 20.00 | 19.17 | 6.02 | 9.66 | 9.68 | 12.72 | 11.67 | 14.73 | 12.90 | 1.69 |
| 2002 | 4.49 | 7.69 | 9.09 | 12.39 | 13.50 | 5.71 | 6.75 | 10.61 | 14.52 | 21.60 | 7.35 |
| 2003 | 3.70 | 7.69 | 6.32 | 20.63 | 8.47 | 6.74 | 8.82 | 5.00 | 12.42 | 10.53 | 15.79 |
| 2004 | 8.70 | 15.38 | 1.00 | 13.04 | 7.33 | 5.26 | 5.06 | 3.37 | 7.94 | 5.93 | 5.19 |
| average | 4.23 | 6.68 | 9.34 | 7.50 | 6.27 | 10.13 | 7.25 | 11.24 | 8.55 | 15.27 | 6.29 |

Note: The average is calculated from 1994 to 2003 and 2004 data is ignored

Panel C: Failure rate and Liquidation rate of individual funds

Failure rate

| Year | Initial numbers | Entry numbers | Exit numbers | Final numbers | Failure Rate % |
|---|---|---|---|---|---|
| 1994 | 136 | 162 | 4 | 294 | 2.94 |
| 1995 | 294 | 212 | 14 | 492 | 4.76 |
| 1996 | 492 | 246 | 47 | 691 | 9.55 |
| 1997 | 691 | 263 | 49 | 905 | 7.09 |
| 1998 | 905 | 232 | 88 | 1049 | 9.72 |
| 1999 | 1049 | 280 | 94 | 1235 | 8.96 |
| 2000 | 1235 | 255 | 129 | 1361 | 10.45 |
| 2001 | 1361 | 268 | 154 | 1475 | 11.32 |
| 2002 | 1475 | 263 | 160 | 1578 | 10.85 |
| 2003 | 1578 | 201 | 153 | 1626 | 9.70 |
| 2004a | 1626 | 0 | 111 | 1515 | 6.83 |
| average | | | | | 8.53 |

Liquidation rate

| Year | Initial numbers | Entry numbers | Liquidated numbers | Final numbers | Liquidated rate % |
|---|---|---|---|---|---|
| 1994 | 136 | 162 | 2 | 296 | 1.47 |
| 1995 | 296 | 212 | 13 | 495 | 4.39 |
| 1996 | 495 | 246 | 22 | 719 | 4.44 |
| 1997 | 719 | 263 | 29 | 953 | 4.03 |
| 1998 | 953 | 232 | 72 | 1113 | 7.56 |
| 1999 | 1113 | 280 | 62 | 1331 | 5.57 |
| 2000 | 1331 | 255 | 59 | 1527 | 4.43 |
| 2001 | 1527 | 268 | 67 | 1728 | 4.39 |
| 2002 | 1728 | 263 | 98 | 1893 | 5.67 |
| 2003 | 1893 | 201 | 99 | 1995 | 5.23 |
| 2004a | 1995 | 0 | 71 | 1924 | 3.56 |
| average | | | | | 4.72 |

Note: The average is calculated from 1994 to 2003 and 2004 data is ignored

Panel D: Failure and Liquidation rate for each category

Failure rate

| year | Convertible Arbitrage | Dedicated Short Bias | Emerging Markets | Equity Market Neutral | Event Driven | Fixed Income Arbitrage | Fund of Funds | Global Macro | Long/Short Equity Hedge | Managed Futures | Mulit-strategy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1994 | - | - | - | - | - | 16.67 | - | - | 2.63 | 8.82 | - |
| 1995 | - | - | - | - | - | 5.26 | 8.33 | 5.88 | 2.53 | 16.18 | - |
| 1996 | 3.33 | - | 4.17 | - | 4.17 | 6.67 | 8.04 | 17.14 | 7.97 | 23.40 | 4.76 |
| 1997 | 5.41 | 14.29 | 6.45 | - | 2.78 | 6.82 | 7.53 | 10.00 | 5.68 | 12.26 | 6.25 |
| 1998 | 9.09 | - | 18.18 | 2.63 | 2.11 | 14.81 | 8.29 | 7.69 | 8.46 | 16.80 | 11.90 |
| 1999 | 3.77 | 10.00 | 12.93 | 19.05 | 12.07 | 9.84 | 3.17 | 12.12 | 6.81 | 14.29 | 2.27 |
| 2000 | 3.28 | 7.14 | 17.07 | 13.10 | 6.25 | 13.64 | 8.49 | 27.94 | 7.08 | 13.43 | 3.92 |
| 2001 | 5.48 | 13.33 | 17.50 | 3.61 | 9.66 | 8.06 | 10.92 | 11.67 | 13.87 | 12.90 | 1.69 |
| 2002 | 2.20 | 7.69 | 9.09 | 11.50 | 12.88 | 4.29 | 6.33 | 10.61 | 13.55 | 21.60 | 7.35 |
| 2003 | 3.57 | 7.69 | 6.32 | 20.63 | 5.65 | 4.49 | 8.40 | 3.75 | 10.19 | 9.65 | 15.79 |
| 2004 | 6.72 | 15.38 | 1.00 | 13.04 | 6.81 | 4.21 | 3.55 | 3.37 | 6.83 | 5.93 | 5.19 |
| average | 3.61 | 6.01 | 9.17 | 7.05 | 5.56 | 9.05 | 6.95 | 10.68 | 7.88 | 14.93 | 5.39 |

Liquidation rate

| year | Convertible Arbitrage | Dedicated Short Bias | Emerging Markets | Equity Market Neutral | Event Driven | Fixed Income Arbitrage | Fund of Funds | Global Macro | Long/Short Equity Hedge | Managed Futures | Mulit-strategy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1994 | - | - | - | - | - | - | - | - | 2.63 | 2.94 | - |
| 1995 | - | - | - | - | - | 5.26 | 8.33 | 5.88 | 2.53 | 13.24 | - |
| 1996 | - | - | 2.78 | - | - | - | 6.25 | 5.71 | 5.80 | 10.64 | - |
| 1997 | 5.26 | 14.29 | 3.23 | - | 1.39 | 2.27 | 5.41 | 5.00 | 4.80 | 5.66 | 6.25 |
| 1998 | 6.67 | - | 9.92 | 2.63 | 2.11 | 14.81 | 7.53 | 5.77 | 6.27 | 14.40 | 11.90 |
| 1999 | 1.82 | - | 7.76 | 17.46 | 6.03 | 4.92 | 1.32 | 6.06 | 3.40 | 10.32 | 2.27 |
| 2000 | - | - | 9.76 | 8.33 | 2.34 | 7.58 | 3.72 | 19.12 | 2.08 | 5.97 | 1.96 |
| 2001 | 1.28 | - | 12.50 | 1.20 | 4.83 | 1.61 | 3.92 | 1.67 | 5.14 | 8.87 | - |
| 2002 | 1.01 | 7.69 | 7.07 | 7.96 | 6.13 | 1.43 | 1.61 | 4.55 | 7.26 | 13.60 | 5.88 |
| 2003 | 1.65 | 7.69 | 4.21 | 18.25 | 3.95 | 2.25 | 4.81 | 2.50 | 6.37 | 7.02 | 13.16 |
| 2004 | 3.85 | 15.38 | 1.00 | 9.57 | 4.71 | 3.16 | 1.63 | 2.25 | 4.60 | 5.93 | 2.60 |
| average | 1.77 | 2.97 | 5.72 | 5.58 | 2.68 | 4.01 | 4.29 | 5.63 | 4.63 | 9.27 | 4.14 |

Note: The average is calculated from 1994 to 2003 and 2004 data is ignored

Panel E: Dollar flows, new entrants and buy and hold returns for each strategy during different periods (unit: Million dollars)

Dollar flows

| Type | 1994-1997 | proportion | 1998-2000 | proportion | 2001-2003 | proportion | 2004 | proportion |
|---|---|---|---|---|---|---|---|---|
| Convertible Arbitrage | 2,339 | 6% | 3,145 | 11% | 13,902 | 18% | 1,291 | 3% |
| Dedicated Short Bias | 261 | 1% | 442 | 2% | -375 | 0% | 58 | 0% |
| Emerging Markets | 5,974 | 16% | -2,547 | -9% | 4,093 | 5% | 3,251 | 7% |
| Equity Market Neutral | 1,475 | 4% | 4,022 | 14% | 3,234 | 4% | -1,168 | -2% |
| Event Driven | 4,459 | 12% | 5,019 | 18% | 12,013 | 15% | 10,120 | 21% |
| Fixed Income Arbitrage | 6,092 | 16% | -811 | -3% | 10,978 | 14% | 5,782 | 12% |
| Global Macro | 3,999 | 11% | -1,999 | -7% | 10,398 | 13% | 5,936 | 12% |
| Long/Short Equity | 8,782 | 24% | 18,732 | 65% | 6,906 | 9% | 10,686 | 22% |
| Managed Futures | 1,038 | 3% | 963 | 3% | 10,415 | 13% | 5,304 | 11% |
| Multi-Strategy | 2,715 | 7% | 1,663 | 6% | 6,812 | 9% | 6,749 | 14% |
| Total | 37,133 | 100% | 28,630 | 100% | 78,376 | 100% | 48,008 | 100% |

New entrants

| Type | 1994-1997 | % | 1998-2000 | % | 2001-2003 | % |
|---|---|---|---|---|---|---|
| Convertible Arbitrage | 40 | 5% | 37 | 5% | 56 | 8% |
| Dedicated Short Bias | 7 | 1% | 8 | 1% | 3 | 0% |
| Emerging Markets | 113 | 13% | 57 | 7% | 18 | 2% |
| Equity Market Neutral | 36 | 4% | 70 | 9% | 77 | 11% |
| Event Driven | 88 | 10% | 77 | 10% | 97 | 13% |
| Fixed Income Arbitrage | 56 | 6% | 33 | 4% | 49 | 7% |
| Global Macro | 57 | 6% | 40 | 5% | 47 | 6% |
| Long/Short Equity | 309 | 35% | 361 | 47% | 300 | 41% |
| Managed Futures | 141 | 16% | 58 | 8% | 49 | 7% |
| Multi-Strategy | 36 | 4% | 26 | 3% | 36 | 5% |
| Total | 883 | 100% | 767 | 100% | 732 | 100% |

Buy and hold returns

| Year/style | Buy and hold return | | | Proportion of dollar flow | | | Change of Proportion | |
|---|---|---|---|---|---|---|---|---|
| | 1994-1997 | 1998-2000 | 2001-2003 | 1994-1997 (1) | 1998-2000 (2) | 2001-2003 (3) | (2)-(1) | (3)-(2) |
| Convertible Arbitrage | 46.74 | 43.66 | 42.52 | 6% | 11% | 18% | 4.7% | 6.8% |
| Dedicated Short Bias | 10.07 | -15.24 | -15.63 | 1% | 2% | 0% | 0.8% | -2.0% |
| Emerging Markets | 66.82 | -15.75 | 108.58 | 16% | -9% | 5% | -25.0% | 14.1% |
| Equity Market Neutral | 58.62 | 37.39 | 22.72 | 4% | 14% | 4% | 10.1% | -9.9% |
| Event Driven | 103.32 | 31.94 | 47.60 | 12% | 18% | 15% | 5.5% | -2.2% |
| Fixed Income Arbitrage | 53.52 | 13.10 | 32.64 | 16% | -3% | 14% | -19.2% | 16.8% |
| Global Macro | 74.68 | 4.10 | 33.69 | 11% | -7% | 13% | -17.8% | 20.2% |
| Long/Short Equity Hedge | 84.71 | 68.87 | 21.79 | 24% | 65% | 9% | 41.8% | -56.6% |
| Managed Futures | 28.03 | 30.58 | 42.76 | 3% | 3% | 13% | 0.6% | 9.9% |
| Multi-strategy | 54.90 | 46.85 | 39.26 | 7% | 6% | 9% | -1.5% | 2.9% |
| Hedge funds | 67.01 | 31.02 | 32.68 | | | | | |
| Fund of fund | 22.10 | 30.78 | 24.52 | | | | | |
| S&P500 | 108.05 | 38.19 | -11.09 | | | | | |
| MSCI | 56.49 | 31.81 | -7.69 | | | | | |

Table 8. Defunct ratio and liquidated ratio during fixed observational period

Example: n=4Y (observed sample period 48 months)

| Inception Year | Sample period | Total no. of funds | No. of defunct funds at the end of sample period | No. of liquidated funds at the end of sample period | Defunct ratio | Liquidated ratio |
|---|---|---|---|---|---|---|
| 1993 | 1994-1997 | 136 | 45 | 31 | 33.09% | 22.79% |
| 1994 | 1995-1998 | 162 | 52 | 23 | 32.10% | 14.20% |
| 1995 | 1996-1999 | 212 | 68 | 36 | 32.08% | 16.98% |
| 1996 | 1997-2000 | 246 | 86 | 55 | 34.96% | 22.36% |
| 1997 | 1998-2001 | 263 | 94 | 53 | 35.74% | 20.15% |
| 1998 | 1999-2002 | 232 | 96 | 38 | 41.38% | 16.38% |
| 1999 | 2000-2003 | 280 | 112 | 64 | 40.00% | 22.86% |
| 2000 | 2001-2004 | 255 | 95 | 53 | 37.25% | 20.78% |

Iindividual fund

| Inception Year | Ratio of defunct fund % | | | | Ratio of Liquidated fund % | | | |
|---|---|---|---|---|---|---|---|---|
| | n= 4Y | n= 3Y | n= 2Y | n= 1Y | n= 4Y | n= 3Y | n= 2Y | n= 1Y |
| 1993 | 33.09 | 25.74 | 11.03 | 3.68 | 22.79 | 17.65 | 7.35 | 1.47 |
| 1994 | 32.10 | 22.84 | 14.81 | 3.70 | 14.20 | 9.88 | 4.94 | 3.09 |
| 1995 | 32.08 | 22.17 | 12.74 | 5.66 | 16.98 | 13.21 | 5.66 | 2.36 |
| 1996 | 34.96 | 25.20 | 15.04 | 4.47 | 22.36 | 17.48 | 12.20 | 2.85 |
| 1997 | 35.74 | 26.24 | 17.87 | 7.98 | 20.15 | 16.73 | 12.55 | 6.08 |
| 1998 | 41.38 | 31.47 | 19.40 | 6.47 | 16.38 | 12.07 | 8.62 | 3.88 |
| 1999 | 40.00 | 30.00 | 20.36 | 5.71 | 22.86 | 16.43 | 11.07 | 2.86 |
| 2000 | 37.25 | 30.20 | 20.39 | 8.63 | 20.78 | 16.86 | 11.37 | 3.53 |
| 2001 | | 26.87 | 21.27 | 9.33 | | 19.03 | 14.55 | 5.60 |
| 2002 | | | 12.17 | 7.22 | | | 7.60 | 4.18 |
| 2003 | | | | 4.98 | | | | 3.48 |
| Trend Parameter | 1.16 | 0.81 | 0.67 | 0.34 | 0.30 | 0.46 | 0.55 | 0.20 |
| t-value | 3.35 | 2.46 | 1.79 | 2.16 | 0.56 | 1.20 | 1.72 | 1.73 |
| | ** | ** | | * | | | | |

Fund of fund

| Inception Year | Ratio of defunct fund % | | | | Ratio of Liquidated fund% | | | |
|---|---|---|---|---|---|---|---|---|
| | n= 4Y | n= 3Y | n= 2Y | n= 1Y | n= 4Y | n= 3Y | n= 2Y | n= 1Y |
| 1993 | 29.63 | 18.52 | 11.11 | 0.00 | 25.93 | 18.52 | 11.11 | 0.00 |
| 1994 | 22.22 | 22.22 | 17.78 | 6.67 | 17.78 | 17.78 | 13.33 | 6.67 |
| 1995 | 32.61 | 28.26 | 15.22 | 4.35 | 23.91 | 23.91 | 13.04 | 4.35 |
| 1996 | 16.28 | 9.30 | 9.30 | 0.00 | 13.95 | 9.30 | 9.30 | 0.00 |
| 1997 | 34.78 | 21.74 | 13.04 | 6.52 | 10.87 | 8.70 | 8.70 | 4.35 |
| 1998 | 30.91 | 20.00 | 14.55 | 3.64 | 16.36 | 10.91 | 9.09 | 1.82 |
| 1999 | 17.78 | 11.11 | 8.89 | 4.44 | 8.89 | 4.44 | 4.44 | 2.22 |
| 2000 | 34.04 | 31.91 | 17.02 | 2.13 | 21.28 | 19.15 | 4.26 | 2.13 |
| 2001 | | 17.72 | 11.39 | 1.27 | | 3.80 | 3.80 | 0.00 |
| 2002 | | | 8.57 | 1.43 | | | 2.86 | 0.00 |
| 2003 | | | | 0.00 | | | | 0.00 |
| Trend Parameter | 0.26 | 0.04 | (0.35) | (0.25) | (1.22) | (1.54) | (1.21) | (0.34) |
| t-value | 0.21 | 0.04 | (0.95) | (1.07) | (1.39) | (1.94) | (7.41) | (1.70) |
| | | | | | | * | *** | |

Note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

Table 9. The survival time of defunct and liquidated funds during fixed observational period

Iindividual fund

| Inception Year | Survival time of defunct fund (Median months) | | | | Survival time of Liquidated fund (Median months) | | | |
|---|---|---|---|---|---|---|---|---|
| | n= 4Y | n= 3Y | n= 2Y | n= 1Y | n= 4Y | n= 3Y | n= 2Y | n= 1Y |
| 1993 | 36 | 33 | 24 | 17 | 34 | 33 | 27 | 19 |
| 1994 | 34 | 30 | 26 | 15 | 37 | 30 | 20 | 15 |
| 1995 | 36 | 27 | 22 | 15 | 37 | 33 | 21 | 15 |
| 1996 | 36 | 30 | 24 | 15 | 30 | 28 | 25 | 14 |
| 1997 | 32 | 27 | 22 | 16 | 29 | 27 | 22 | 15 |
| 1998 | 33 | 28 | 22 | 15 | 27 | 22 | 19 | 16 |
| 1999 | 32 | 27 | 24 | 16 | 33 | 27 | 25 | 14 |
| 2000 | 32 | 27 | 21 | 18 | 32 | 30 | 23 | 18 |
| 2001 | | 22 | 20 | 15 | | 25 | 19 | 15 |
| 2002 | | | 20 | 15 | | | 20 | 16 |
| 2003 | | | | 16 | | | | 16 |
| Trend Parameter | -0.63 | -0.91 | -0.53 | 0.00 | -0.79 | -0.83 | -0.36 | -0.01 |
| t-value | -3.05 | -4.02 | -3.64 | 0.00 | -1.60 | -2.16 | -1.20 | -0.09 |
| | ** | ** | ** | | | ** | | |

Fund of fund

| Inception Year | Survival time of defunct fund (Median months) | | | | Survival time of Liquidated fund (Median months) | | | |
|---|---|---|---|---|---|---|---|---|
| | n= 4Y | n= 3Y | n= 2Y | n= 1Y | n= 4Y | n= 3Y | n= 2Y | n= 1Y |
| 1993 | 35 | 29 | 26 | 0 | 34 | 29 | 26 | 0 |
| 1994 | 27 | 27 | 26 | 18 | 26 | 26 | 24 | 18 |
| 1995 | 35 | 34 | 27 | 17 | 34 | 34 | 25 | 17 |
| 1996 | 31 | 24 | 24 | 0 | 28 | 24 | 24 | 0 |
| 1997 | 36 | 27 | 23 | 21 | 26 | 24 | 24 | 22 |
| 1998 | 37 | 33 | 31 | 16 | 36 | 32 | 28 | 14 |
| 1999 | 42 | 30 | 23 | 16 | 43 | 23 | 23 | 16 |
| 2000 | 32 | 32 | 32 | 16 | 36 | 34 | 19 | 16 |
| 2001 | | 30 | 21 | 15 | | 33 | 33 | 0 |
| 2002 | | | 27 | 17 | | | 29 | 0 |
| 2003 | | | | 0 | | | | 0 |
| Trend Parameter | 0.74 | 0.34 | 0.05 | 0.17 | 1.19 | 0.46 | 0.36 | -0.86 |
| t-value | 1.13 | 0.78 | 0.13 | 0.21 | 1.40 | 0.74 | 0.83 | -1.00 |

note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

Figure 11. Trend of cumulative returns for benchmark index vs. Hedge fund index between January 1994 and November 2004.

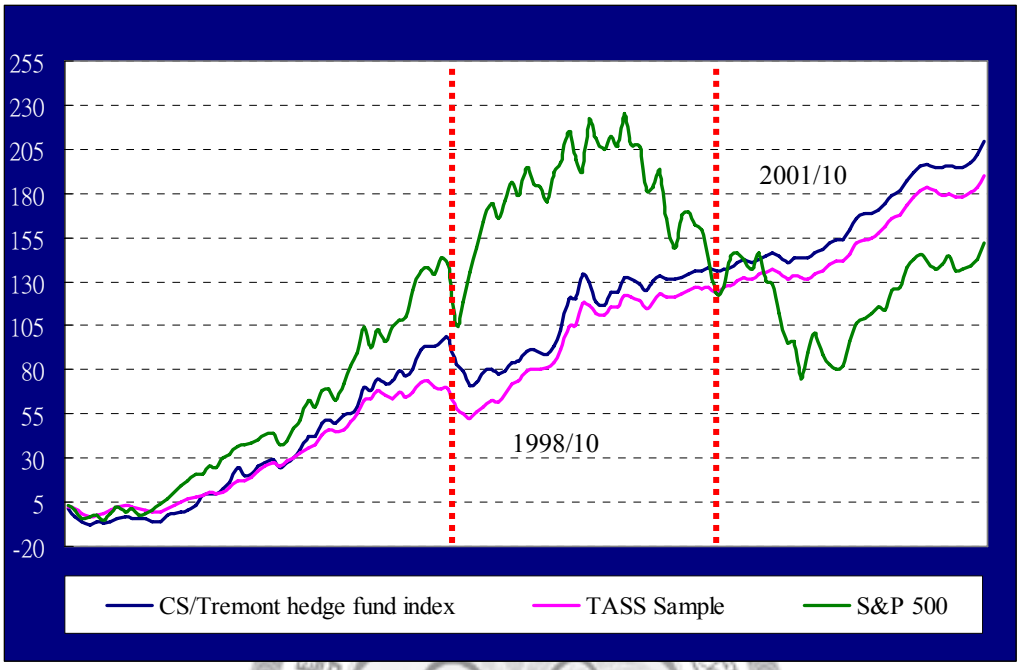
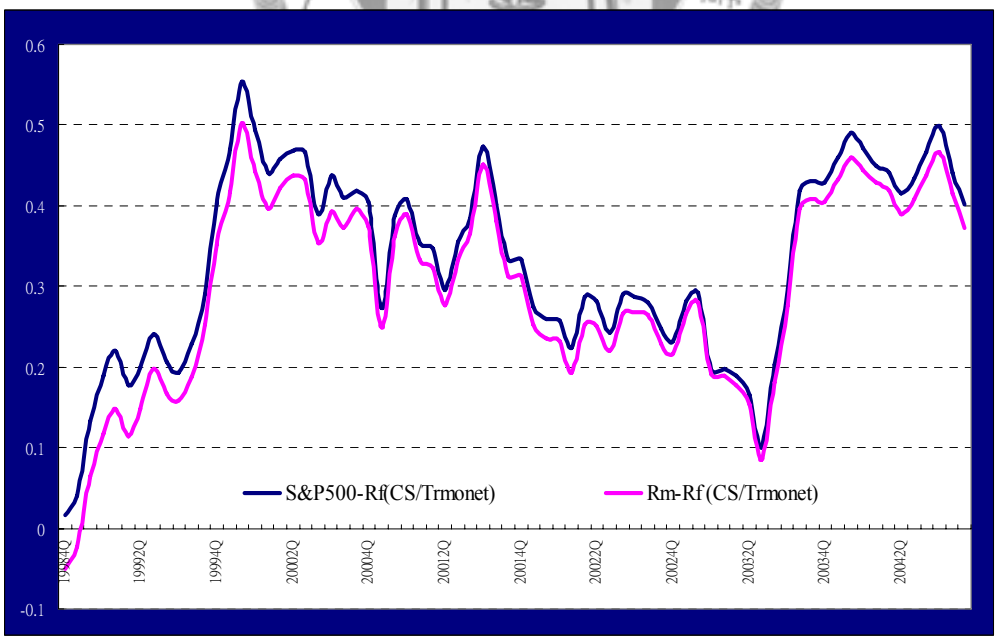



Figure 12. Trend of alpha for the CS/Tremont hedge funds index by employing a rolling 60-month window




Note: Rm-Rf , Rm is a value-weight return on ALL NYSE, AMEX, and NASDAQ stocks from CRSP minus the one-month Treasury bill rate.

Figure 13. Trend of alpha for the CS/Tremont hedge funds index and TASS sample by employing a rolling 60-months window

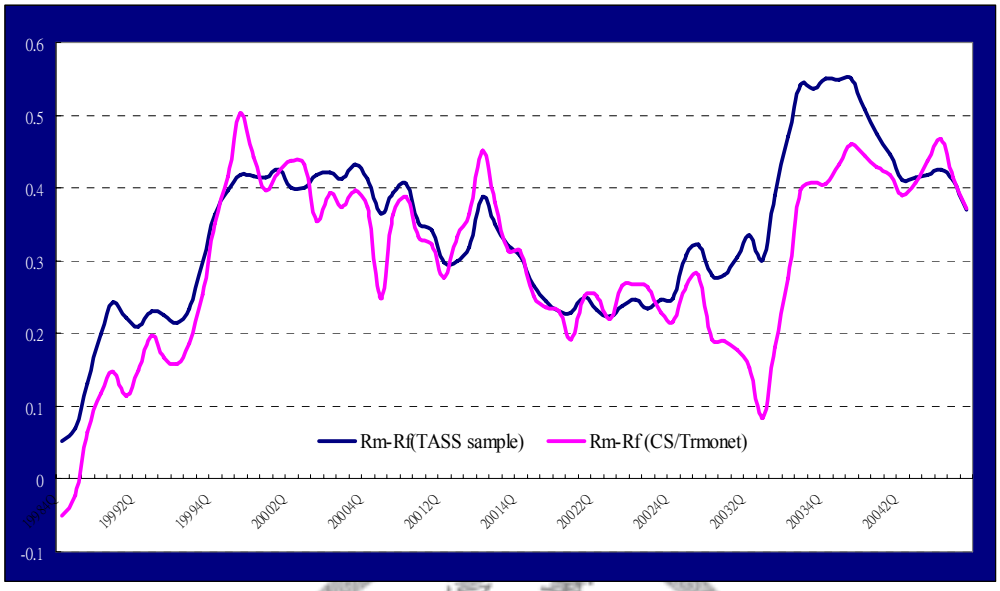



Table10.R square distribution of each category of hedge funds by employing the Fama-French three factors model for a rolling 60-month window

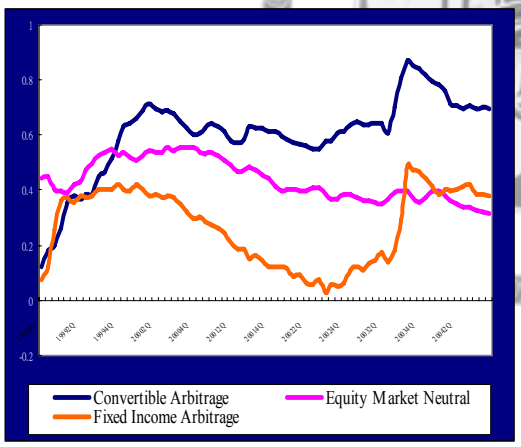
| Style of strategies | TASS Sample portfolio--R square | | | | CS/Tremont index-R square | | | |
|---|---|---|---|---|---|---|---|---|
| | mean | median | max | min | mean | median | max | min |
| Convertible Arbitrage | 0.148 | 0.14 | 0.28 | 0.05 | 0.123 | 0.12 | 0.25 | 0.01 |
| Dedicated Short Bias | 0.847 | 0.85 | 0.89 | 0.79 | 0.813 | 0.80 | 0.91 | 0.76 |
| Emerging Markets | 0.497 | 0.50 | 0.59 | 0.38 | 0.490 | 0.50 | 0.65 | 0.28 |
| Equity Market Neutral | 0.230 | 0.27 | 0.39 | 0.05 | 0.270 | 0.32 | 0.40 | 0.09 |
| Event Driven | 0.485 | 0.49 | 0.53 | 0.40 | 0.538 | 0.55 | 0.62 | 0.43 |
| Fixed Income Arbitrage | 0.065 | 0.06 | 0.14 | 0.03 | 0.047 | 0.05 | 0.11 | 0.01 |
| Global Macro | 0.076 | 0.06 | 0.16 | 0.04 | 0.165 | 0.17 | 0.23 | 0.10 |
| Long/Short Equity Hedge | 0.767 | 0.75 | 0.86 | 0.69 | 0.748 | 0.72 | 0.88 | 0.63 |
| Managed Futures | 0.120 | 0.12 | 0.28 | 0.02 | 0.083 | 0.05 | 0.22 | 0.01 |
| Multi-strategy | 0.363 | 0.36 | 0.43 | 0.23 | 0.504 | 0.51 | 0.56 | 0.38 |
| Hedge fund | 0.637 | 0.65 | 0.69 | 0.52 | 0.506 | 0.50 | 0.62 | 0.38 |
| Fund of fund | 0.512 | 0.53 | 0.59 | 0.38 | 0.640 | 0.65 | 0.72 | 0.52 |

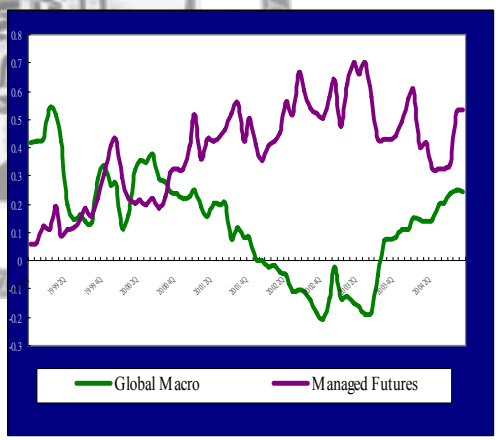
Table11.Significant proportion of each category of hedge funds by employing the Fama-French three factors model for a rolling 60-month window

| Style of strategies | TASS Sample portfolio--Significant | | | | CS/Tremont index-Significant | | | |
|---|---|---|---|---|---|---|---|---|
| | No significant | significant α=10% | significant α=5% | significant α=1% | No significant | significant α=10% | significant α=5% | significant α=1% |
| Convertible Arbitrage | 6% | 94% | 94% | 88% | 13% | 88% | 81% | 53% |
| Dedicated Short Bias | 76% | 24% | 15% | 2% | 78% | 22% | 8% | 0% |
| Emerging Markets | 70% | 30% | 23% | 21% | 73% | 27% | 19% | 4% |
| Equity Market Neutral | 0% | 100% | 100% | 100% | 0% | 100% | 97% | 90% |
| Event Driven | 0% | 100% | 90% | 68% | 74% | 26% | 22% | 22% |
| Fixed Income Arbitrage | 64% | 36% | 19% | 19% | 81% | 19% | 19% | 19% |
| Global Macro | 100% | 0% | 0% | 0% | 81% | 19% | 19% | 14% |
| Long/Short Equity Hedge | 8% | 92% | 86% | 58% | 23% | 77% | 61% | 23% |
| Managed Futures | 100% | 0% | 0% | 0% | 100% | 0% | 0% | 0% |
| Multi-strategy | 13% | 88% | 81% | 35% | 78% | 22% | 22% | 21% |
| Hedge fund | 33% | 67% | 48% | 21% | 79% | 21% | 19% | 2% |
| Fund of fund | 71% | 29% | 23% | 13% | 81% | 19% | 10% | 0% |

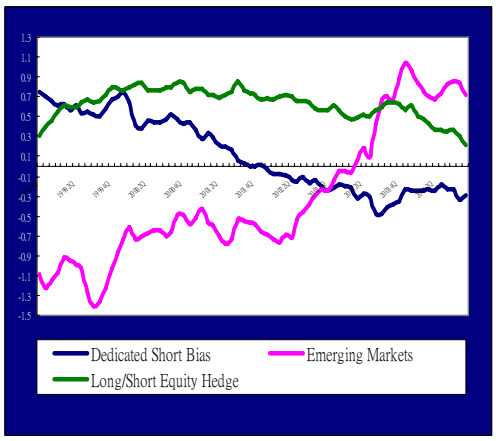
Figure 12: Alpha trend of each strategy of the TASS sample by employing a rolling 60month window by $R^2$ classified

Average $R^2$<=0.3




Average $R^2$>0.3



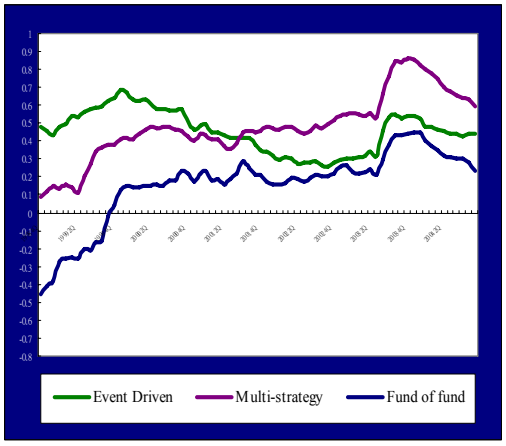



Table 12. Test results of the interval between two losses varying over time between during January 1994 and November 2004

| Style of strategies | TASS sample portfolio | | | | | CS/Tremont index | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | R squared | parmeters | t-value | p_value | | R squared | parms | t-value | p_value | |
| Convertible Arbitrage | 0.083 | 0.26 | 1.38 | 0.18 | | 0.050 | 0.20 | 1.17 | 0.25 | |
| Dedicated Short Bias | 0.003 | -0.04 | -0.49 | 0.63 | | 0.002 | -0.03 | -0.38 | 0.71 | |
| Emerging Markets | 0.059 | 0.18 | 1.67 | 0.10 | | 0.030 | 0.13 | 1.26 | 0.21 | |
| Equity Market Neutral | 0.247 | 0.38 | 1.98 | 0.07 | * | 0.343 | 0.46 | 3.23 | 0.00 | *** |
| Event Driven | 0.123 | 0.33 | 1.63 | 0.12 | | 0.169 | 0.35 | 2.16 | 0.04 | ** |
| Fixed Income Arbitrage | 0.176 | 0.33 | 2.17 | 0.04 | ** | 0.118 | 0.28 | 1.80 | 0.09 | * |
| Global Macro | 0.018 | 0.10 | 0.92 | 0.36 | | 0.058 | 0.18 | 1.49 | 0.15 | |
| Long/Short Equity Hedge | 0.011 | 0.07 | 0.69 | 0.50 | | 0.009 | 0.07 | 0.60 | 0.55 | |
| Managed Futures | 0.028 | 0.10 | 1.28 | 0.21 | | 0.000 | 0.00 | 0.02 | 0.99 | |
| Multi-strategy | 0.008 | 0.10 | 0.44 | 0.66 | | 0.060 | 0.20 | 1.34 | 0.19 | |
| Hedge fund | 0.012 | 0.09 | 0.70 | 0.49 | | 0.021 | 0.11 | 0.90 | 0.38 | |
| Fund of fund | 0.117 | 0.24 | 2.25 | 0.03 | ** | 0.018 | 0.11 | 0.88 | 0.38 | |
| S&P500 | 0.018 | -0.10 | -0.94 | 0.35 | | 0.018 | -0.10 | -0.94 | 0.35 | |
| MSCI | 0.022 | -0.10 | -1.06 | 0.30 | | 0.022 | -0.10 | -1.06 | 0.30 | |

note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

Figure13 Pattern of the CS/Tremont hedge fund composite index and the asset-weight portfolio of the TASS sample by employing a rolling 36 month correlation with the S&P500 index between January 1994 and November2004

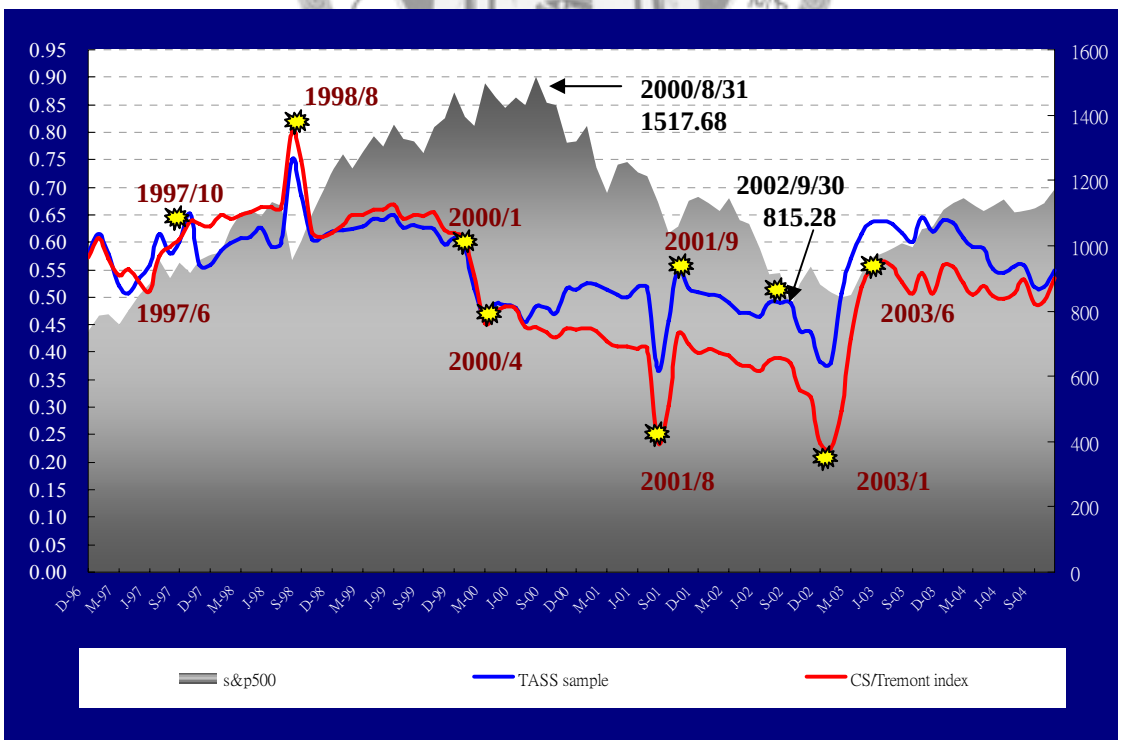


Figure14 Pattern of the CS/Tremont Long/short Equity Hedge index and the asset-weight portfolio of the TASS sample by employing a rolling 36 month correlation with the S&P500 index between January 1994 and November2004

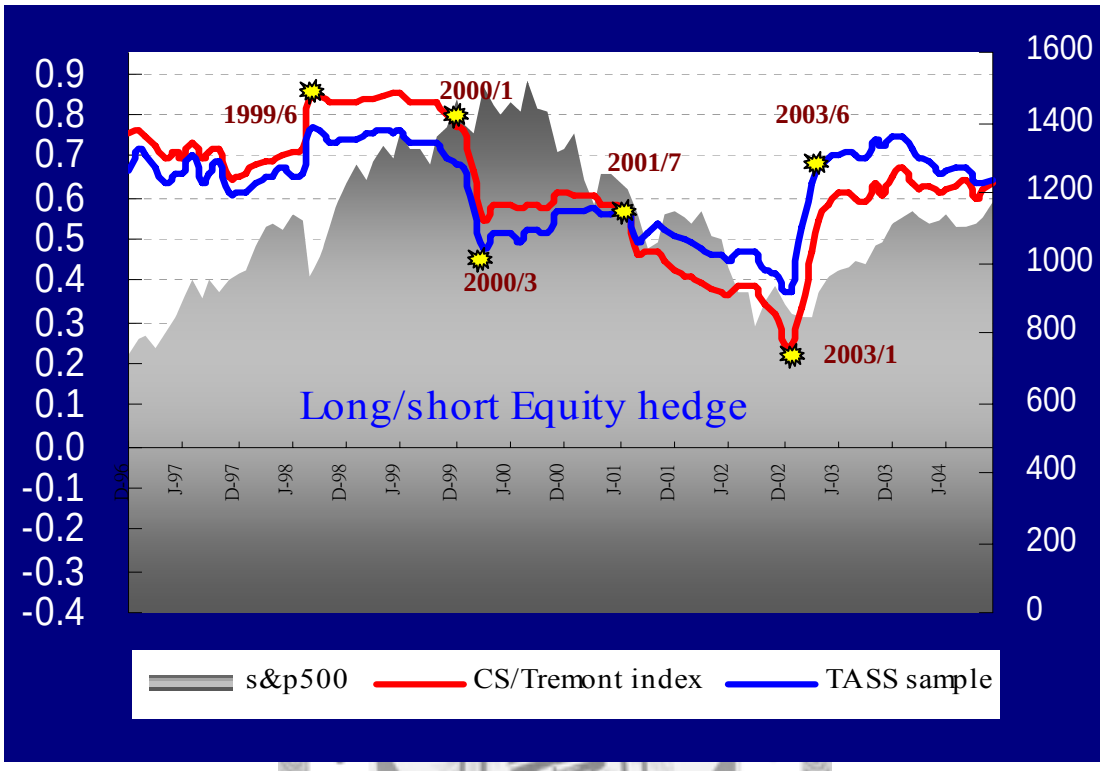



Figure15 Pattern of the CS/Tremont Long/short Equity Hedge index and the asset-weight portfolio of the TASS sample by employing a rolling 36 month correlation with the Nasdaq index between January 1994 and November2004

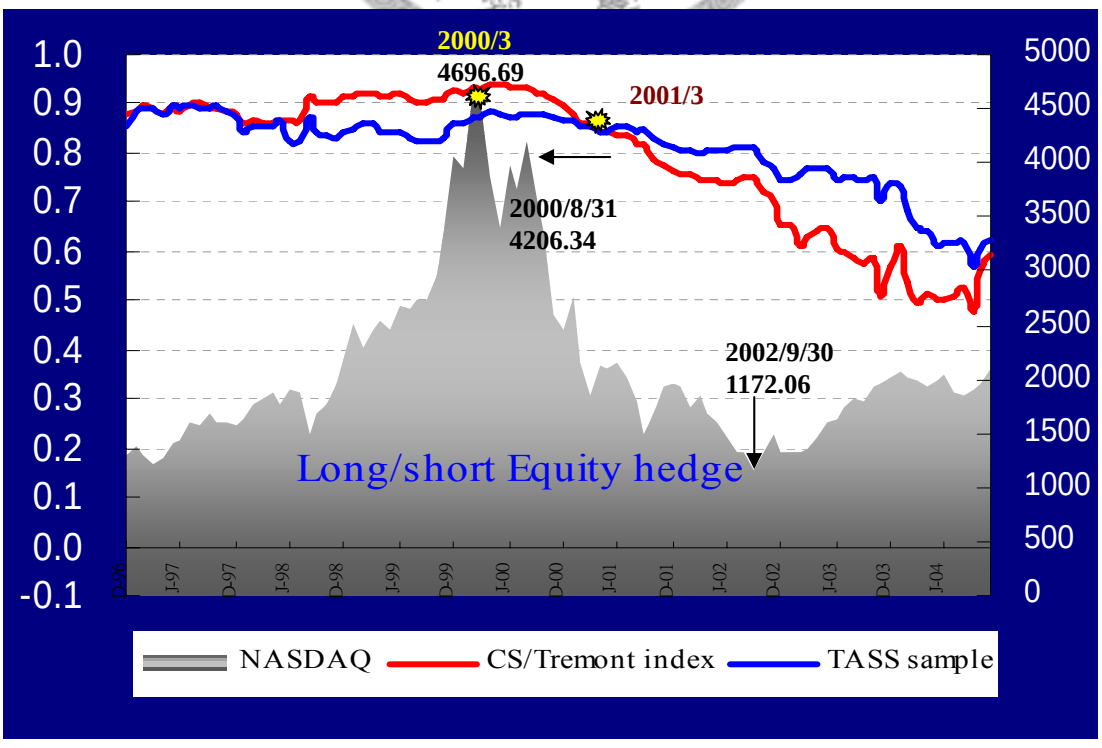
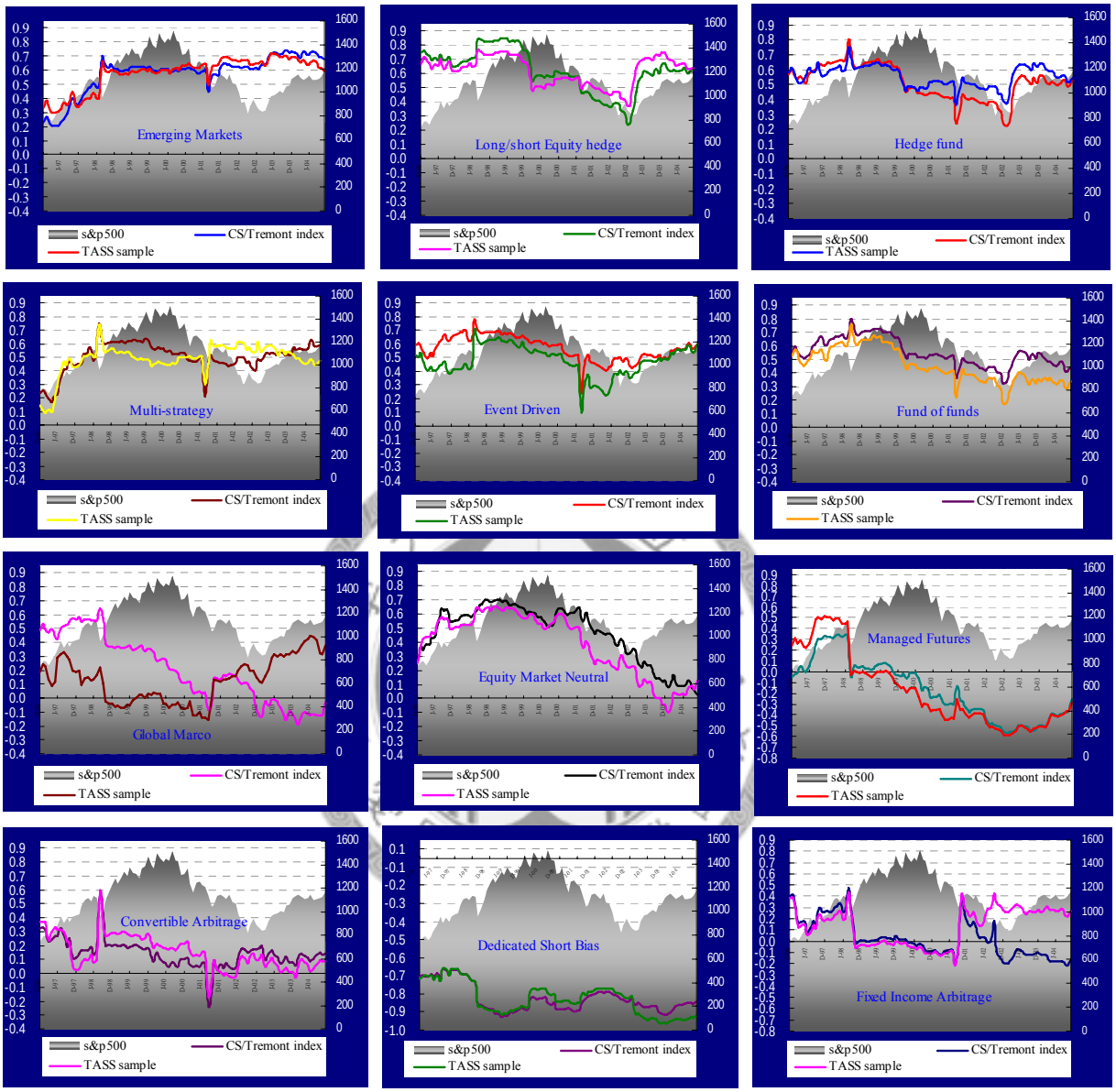


Figure16 Pattern of each strategy of the CS/Tremont hedge funds composite index and the asset-weight portfolio of the TASS sample by employing a rolling 36 month correlation with the S&P500 index between January 1994 and November2004




The pattern of fixed income arbitrage and CB arbitrage by employing a rolling 36 month correlation with the Salomon US Treasury 5 Year index

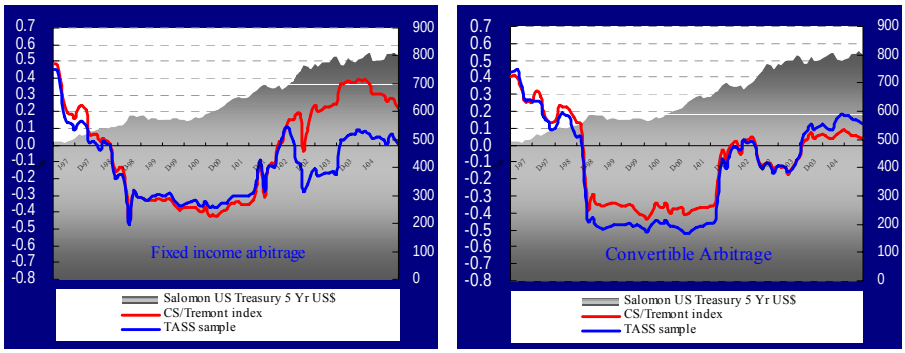
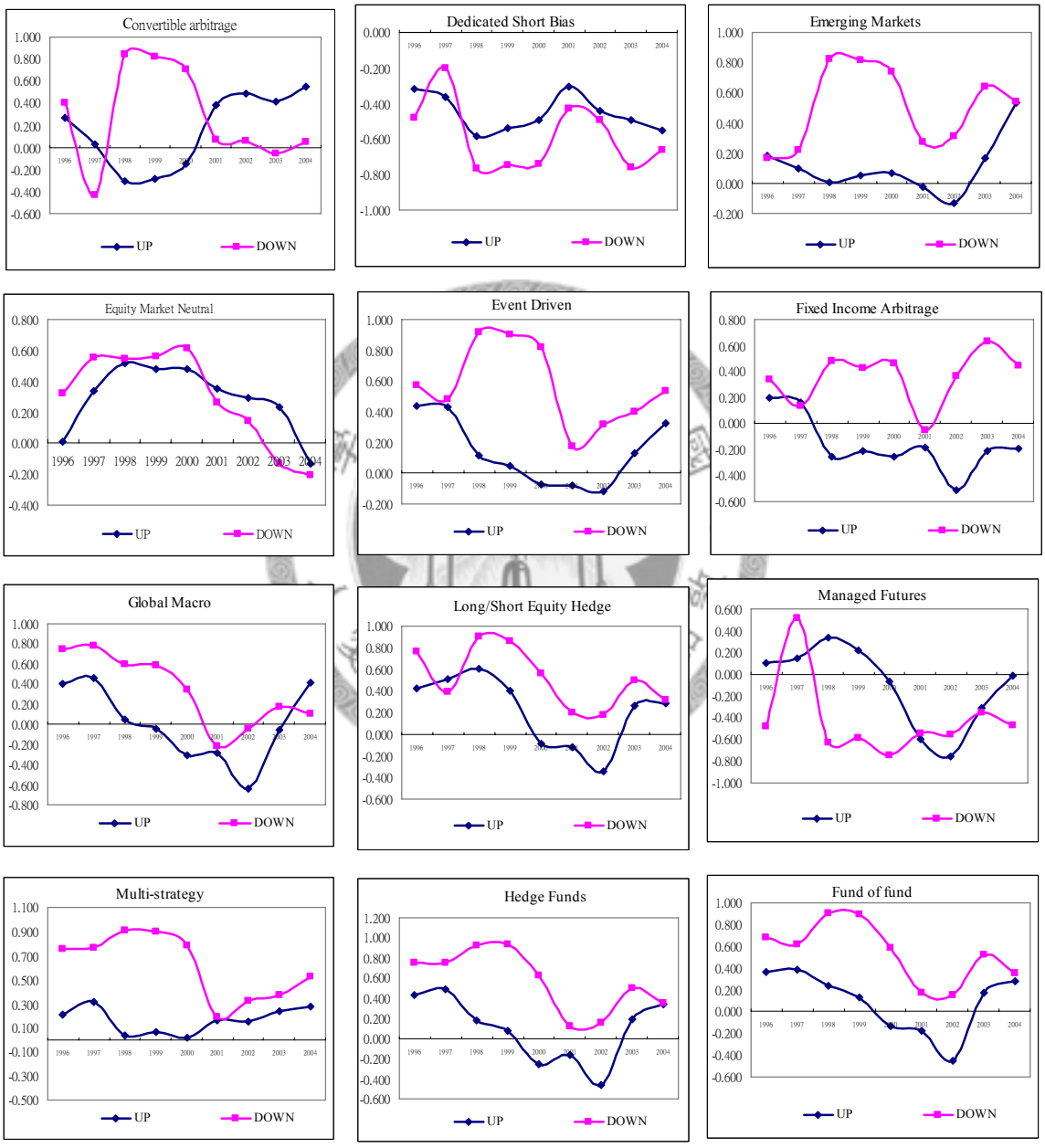
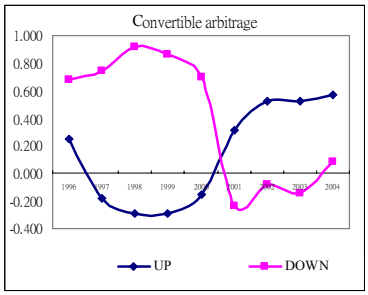


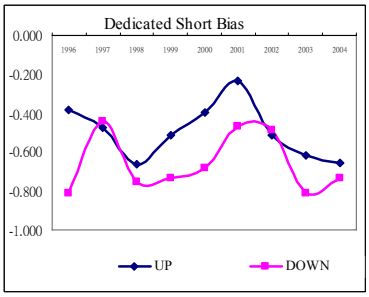
Figure 17: Pattern of the correlation between the sub-sector index with the S&P500 at the end of each year between January 1994 and November 2004. Up (down) means that the correlation was calculated with the non-negative returns (negative) of the S&P 500 index and the corresponding returns for hedge funds during 36 consecutive months.

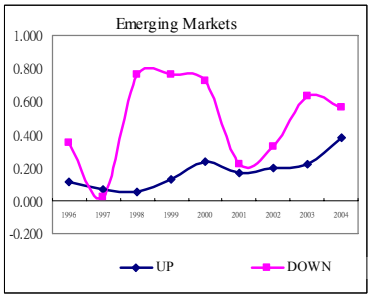
Panel A: CS/Tremont sub-sector index

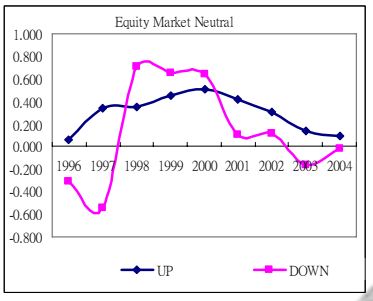


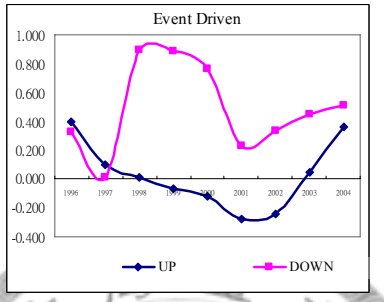
Panel B: asset-weight portfolio of sub-sector TASS sample

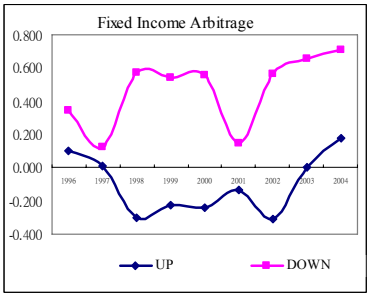


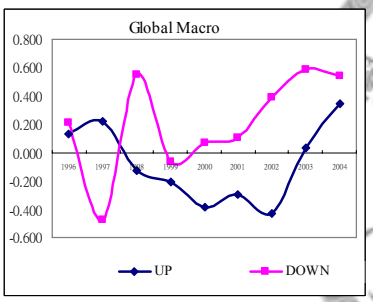



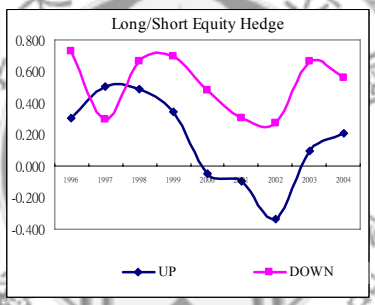



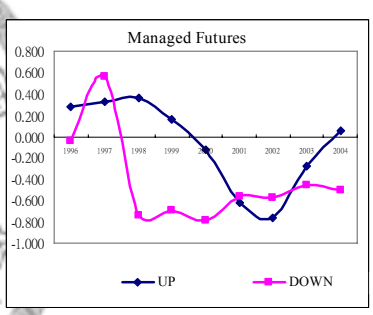



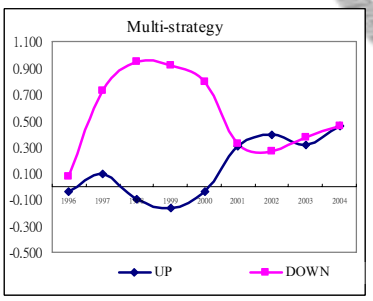



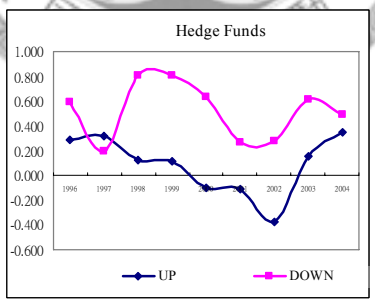



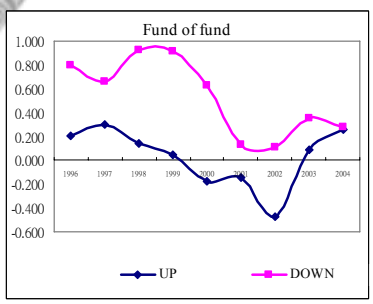



Table 13 Descriptive statistics of monthly hedge funds return and correlation with US equity under each scenario.

Panel A The CS/Tremont sub-sector index vs. S&P 500 index (market extreme conditions)

| Scenario Group | Sample size | Convertible Arbitrage | Dedicated Short Bias | Emerging Markets | Equity Market Neutral | Event Driven | Fixed Income Arbitrage | Global Macro | Long/Short Equity Hedge | Managed Futures | Multi-strategy | Fund of fund | Hedge fund | S&P500 | MSCI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean Return | | | | | | | | | | | | | | | |
| 1 | 27 | 0.74 | 5.50 | -2.90 | 0.36 | -0.43 | 0.37 | -0.81 | -1.83 | 1.79 | -0.40 | -0.81 | -1.14 | -5.64 | -5.21 |
| 2 | 26 | 0.82 | 2.00 | 0.14 | 0.69 | 0.62 | 0.62 | 1.72 | 0.13 | 0.17 | 0.73 | 0.37 | 0.75 | -1.17 | -1.22 |
| 3 | 26 | 0.31 | -1.35 | 1.24 | 0.74 | 1.15 | 0.55 | 1.07 | 1.19 | 0.44 | 1.03 | 0.72 | 0.99 | 1.27 | 1.48 |
| 4 | 25 | 1.16 | -2.41 | 2.40 | 0.84 | 1.66 | 0.93 | 1.57 | 2.26 | 0.03 | 1.25 | 1.28 | 1.71 | 3.30 | 2.65 |
| 5 | 27 | 0.89 | -4.58 | 2.88 | 1.47 | 1.69 | 0.34 | 2.26 | 3.28 | 0.64 | 1.66 | 1.59 | 2.22 | 6.39 | 5.26 |
| Median return | | | | | | | | | | | | | | | |
| 1 | 27 | 1.21 | 4.13 | -1.52 | 0.31 | 0.12 | 0.70 | 0.25 | -1.42 | 1.65 | 0.11 | -0.64 | -0.59 | -5.09 | -4.95 |
| 2 | 26 | 0.73 | 1.29 | 1.00 | 0.69 | 0.46 | 0.67 | 1.24 | -0.24 | -0.58 | 0.45 | 0.30 | 0.30 | -1.38 | -1.38 |
| 3 | 26 | 0.90 | -1.34 | 1.28 | 0.75 | 1.22 | 0.71 | 1.22 | 1.17 | 0.82 | 0.98 | 0.69 | 1.04 | 1.23 | 1.55 |
| 4 | 25 | 1.32 | -1.60 | 2.69 | 0.80 | 1.70 | 1.09 | 1.32 | 2.03 | -0.27 | 1.78 | 1.27 | 1.45 | 3.46 | 2.75 |
| 5 | 27 | 1.12 | -5.75 | 2.97 | 1.32 | 2.23 | 0.97 | 2.34 | 3.47 | 1.21 | 1.89 | 1.56 | 1.96 | 5.91 | 5.45 |
| Mimium of return | | | | | | | | | | | | | | | |
| 1 | 27 | -4.64 | -2.73 | -23.03 | -1.15 | -11.77 | -2.00 | -6.97 | -11.44 | -7.27 | -11.52 | -6.30 | -7.55 | -14.58 | -13.45 |
| 2 | 26 | -3.15 | -8.65 | -9.78 | -0.34 | -1.20 | -0.49 | -2.85 | -3.45 | -6.46 | -1.10 | -1.69 | -1.17 | -2.68 | -3.76 |
| 3 | 26 | -2.52 | -6.64 | -8.36 | -0.11 | -0.78 | -0.98 | -7.07 | -1.58 | -6.10 | -1.00 | -1.81 | -3.59 | 0.59 | -0.56 |
| 4 | 25 | -1.36 | -7.71 | -9.98 | -1.00 | -0.79 | -1.08 | -2.88 | -0.74 | -9.35 | -2.01 | -2.30 | -1.97 | 2.08 | -1.67 |
| 5 | 27 | -4.68 | -8.69 | -7.40 | -0.38 | -2.96 | -6.96 | -11.55 | -3.98 | -8.62 | -4.74 | -1.46 | -4.57 | 4.46 | 1.06 |
| Maxium of return | | | | | | | | | | | | | | | |
| 1 | 27 | 3.57 | 22.71 | 5.20 | 1.84 | 2.27 | 1.52 | 3.63 | 1.54 | 9.95 | 1.98 | 1.31 | 1.28 | -2.69 | -0.41 |
| 2 | 26 | 3.37 | 10.89 | 6.04 | 2.13 | 2.30 | 1.75 | 10.60 | 11.14 | 7.76 | 4.38 | 5.13 | 6.49 | 0.51 | 1.51 |
| 3 | 26 | 1.50 | 4.94 | 9.29 | 1.97 | 2.57 | 1.55 | 5.14 | 8.32 | 6.89 | 2.98 | 4.31 | 4.96 | 1.91 | 2.93 |
| 4 | 25 | 2.68 | 4.30 | 16.42 | 2.92 | 3.68 | 2.02 | 10.46 | 6.13 | 9.46 | 3.88 | 3.37 | 6.97 | 4.35 | 6.43 |
| 5 | 27 | 3.46 | 2.93 | 15.34 | 3.26 | 3.58 | 1.73 | 10.16 | 13.01 | 6.87 | 4.66 | 5.76 | 8.53 | 9.67 | 8.91 |
| Correlation with S&P500 | | | | | | | | | | | | | | | |
| 1 | 27 | 0.45 ** | -0.67 *** | 0.60 *** | 0.12 | 0.67 *** | 0.27 | -0.20 | 0.43 ** | -0.52 *** | 0.66 *** | 0.40 ** | 0.29 | 1.00 | 0.92 *** |
| 2 | 26 | -0.02 | -0.07 | 0.14 | 0.13 | -0.08 | 0.05 | 0.28 | 0.09 | 0.27 | -0.07 | 0.12 | 0.23 | 1.00 | 0.49 ** |
| 3 | 26 | -0.06 | -0.15 | 0.22 | -0.06 | 0.30 | 0.24 | 0.45 ** | 0.35 * | 0.25 | 0.30 | 0.36 * | 0.45 ** | 1.00 | 0.45 ** |
| 4 | 25 | 0.20 | -0.25 | 0.16 | -0.21 | 0.24 | 0.13 | 0.07 | 0.16 | -0.13 | 0.23 | 0.21 | 0.15 | 1.00 | 0.42 ** |
| 5 | 27 | 0.06 | -0.27 | 0.05 | 0.22 | -0.23 | -0.37 * | -0.31 | -0.34 * | -0.33 * | -0.18 | -0.28 | -0.37 * | 1.00 | 0.52 *** |

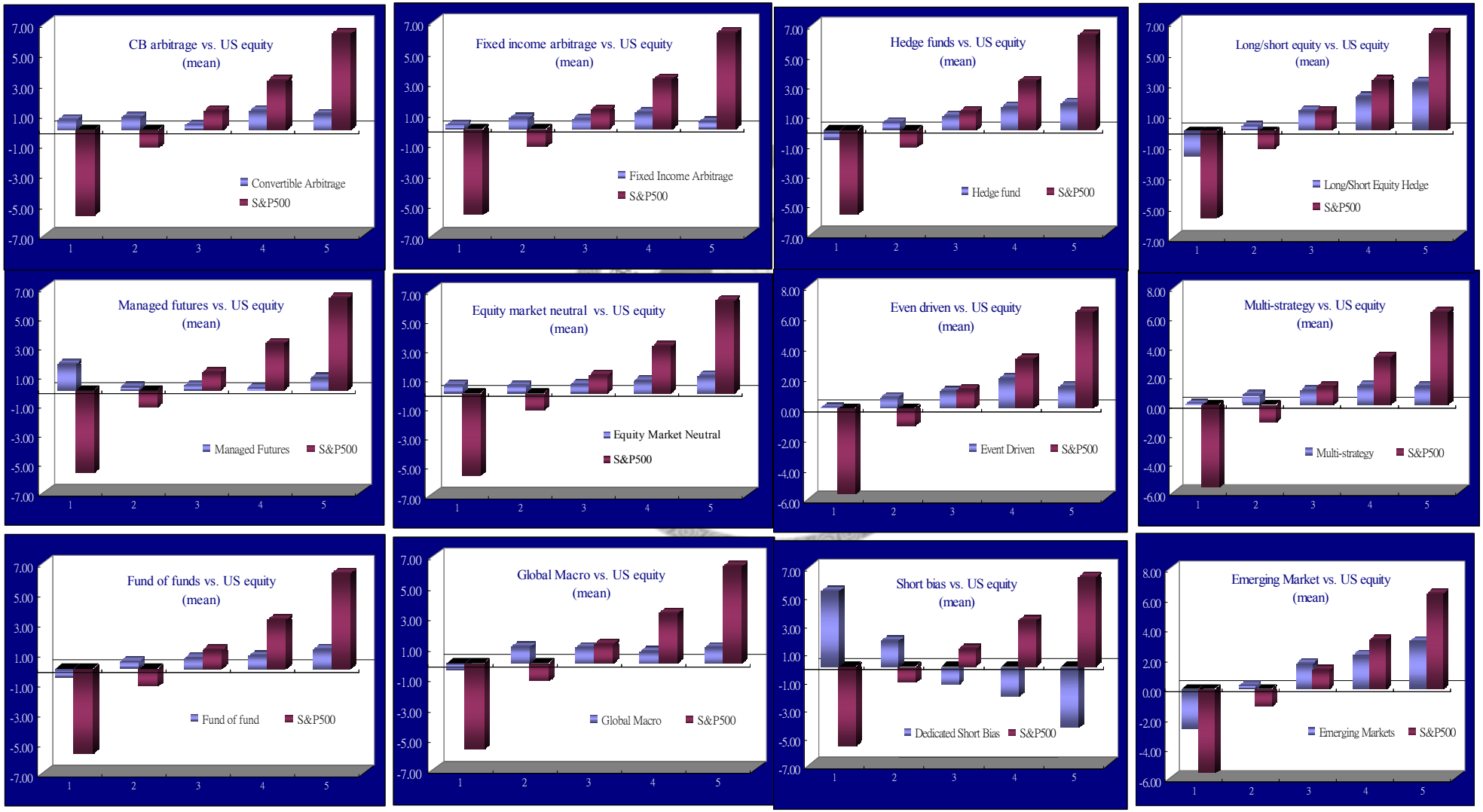
note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

Panel B: Asset-weight portfolio of TASS sample (extreme case)

| Scenario Group | Sample size | Convertible Arbitrage | Dedicated Short Bias | Emerging Markets | Equity Market Neutral | Event Driven | Fixed Income Arbitrage | Global Macro | Long/Short Equity Hedge | Managed Futures | Multi-strategy | Fund of fund | Hedge fund | S&P500 | MSCI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean Return | | | | | | | | | | | | | | | |
| 1 | 27 | 0.70 | 5.41 | -2.65 | 0.56 | 0.05 | 0.27 | -0.45 | -1.67 | 1.83 | 0.09 | -0.66 | -0.67 | -5.64 | -5.2054 |
| 2 | 26 | 0.89 | 1.86 | 0.25 | 0.51 | 0.72 | 0.74 | 1.12 | 0.30 | 0.25 | 0.72 | 0.49 | 0.51 | -1.17 | -1.2227 |
| 3 | 26 | 0.32 | -1.28 | 1.68 | 0.62 | 1.17 | 0.67 | 1.06 | 1.36 | 0.36 | 1.04 | 0.73 | 0.97 | 1.27 | 1.4842 |
| 4 | 25 | 1.31 | -2.15 | 2.29 | 0.87 | 2.01 | 1.09 | 0.78 | 2.22 | 0.19 | 1.36 | 0.86 | 1.58 | 3.30 | 2.6546 |
| 5 | 27 | 1.05 | -4.33 | 3.21 | 1.21 | 1.45 | 0.50 | 1.05 | 3.18 | 0.88 | 1.30 | 1.30 | 1.82 | 6.39 | 5.2594 |
| Median return | | | | | | | | | | | | | | | |
| 1 | 27 | 1.15 | 4.93 | -1.53 | 0.54 | 0.69 | 0.80 | -0.18 | -1.51 | 1.14 | 0.10 | -0.38 | -0.40 | -5.09 | -4.95 |
| 2 | 26 | 0.80 | 1.91 | 0.75 | 0.45 | 0.51 | 0.83 | 0.61 | -0.02 | -0.23 | 0.59 | 0.36 | 0.65 | -1.38 | -1.38 |
| 3 | 26 | 0.71 | -0.90 | 2.29 | 0.53 | 1.05 | 0.67 | 1.17 | 1.43 | 0.57 | 0.89 | 0.55 | 0.95 | 1.23 | 1.55 |
| 4 | 25 | 1.43 | -1.93 | 2.59 | 0.69 | 1.84 | 1.37 | 0.53 | 1.65 | 0.00 | 1.57 | 1.35 | 1.82 | 3.46 | 2.75 |
| 5 | 27 | 1.40 | -4.93 | 3.14 | 1.22 | 1.74 | 1.13 | 0.99 | 2.93 | 1.60 | 1.52 | 1.35 | 2.00 | 5.91 | 5.45 |
| Mimium of return | | | | | | | | | | | | | | | |
| 1 | 27 | -4.31 | -0.45 | -24.67 | -0.74 | -7.96 | -2.85 | -3.72 | -7.77 | -5.45 | -7.28 | -5.61 | -6.48 | -14.58 | -13.45 |
| 2 | 26 | -0.26 | -12.56 | -12.12 | -0.30 | -0.85 | -0.39 | -2.35 | -2.56 | -5.36 | -0.43 | -0.68 | -1.84 | -2.68 | -3.76 |
| 3 | 26 | -4.47 | -7.59 | -8.17 | -0.50 | -1.13 | -1.32 | -1.54 | -1.68 | -6.12 | -0.39 | -1.15 | -1.73 | 0.59 | -0.56 |
| 4 | 25 | -0.56 | -7.26 | -7.35 | -0.46 | -0.21 | -1.30 | -3.77 | -0.72 | -3.64 | -1.94 | -4.23 | -1.72 | 2.08 | -1.67 |
| 5 | 27 | -3.55 | -8.47 | -7.68 | 0.25 | -1.57 | -8.84 | -4.87 | -2.49 | -6.45 | -2.70 | -2.24 | -1.80 | 4.46 | 1.06 |
| Maxium of return | | | | | | | | | | | | | | | |
| 1 | 27 | 2.78 | 21.73 | 2.64 | 1.74 | 1.96 | 1.89 | 2.35 | 2.09 | 11.64 | 2.14 | 1.29 | 1.30 | -2.69 | -0.41 |
| 2 | 26 | 3.52 | 10.16 | 4.87 | 1.60 | 2.70 | 2.21 | 10.02 | 11.40 | 7.59 | 3.71 | 4.86 | 5.91 | 0.51 | 1.51 |
| 3 | 26 | 1.95 | 4.00 | 8.87 | 1.64 | 4.56 | 1.88 | 3.66 | 8.43 | 4.59 | 3.51 | 4.39 | 4.49 | 1.91 | 2.93 |
| 4 | 25 | 3.00 | 2.60 | 10.38 | 2.43 | 5.29 | 2.60 | 8.20 | 5.66 | 6.35 | 4.04 | 2.77 | 3.61 | 4.35 | 6.43 |
| 5 | 27 | 2.47 | 3.81 | 14.21 | 2.60 | 2.75 | 2.18 | 5.96 | 12.14 | 6.76 | 3.68 | 5.73 | 6.56 | 9.67 | 8.91 |
| Correlation with S&P500 | | | | | | | | | | | | | | | |
| 1 | 27 | 0.34 * | -0.71 *** | 0.58 *** | 0.45 ** | 0.69 *** | 0.37 * | 0.00 | 0.46 ** | -0.63 *** | 0.72 *** | 0.27 | 0.54 *** | 1.00 | 0.91502 *** |
| 2 | 26 | -0.14 | -0.06 | 0.13 | 0.04 | -0.10 | 0.04 | -0.45 ** | -0.01 | 0.33 * | -0.18 | 0.02 | -0.02 | 1.00 | 0.49121 ** |
| 3 | 26 | 0.02 | -0.42 ** | 0.27 | -0.09 | 0.29 | 0.15 | 0.20 | 0.38 * | 0.31 | 0.29 | 0.32 | 0.35 * | 1.00 | 0.44612 ** |
| 4 | 25 | 0.28 | -0.28 | 0.23 | -0.12 | 0.12 | 0.06 | -0.04 | 0.22 | 0.02 | 0.22 | 0.30 | 0.29 | 1.00 | 0.42421 ** |
| 5 | 27 | -0.03 | -0.28 | 0.14 | 0.01 | -0.24 | -0.28 | -0.44 ** | -0.32 | -0.37 * | 0.04 | -0.25 | -0.29 | 1.00 | 0.51825 *** |

note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

Figure 18: Payoff of asset-weight portfolio of the sectoral TASS sample vs. the S&P 500 index in five Scenarios



Appendix:

Table A1: Estimated Alpha of hedge funds by employing the Fama-French three factors model at the end of each year during 1994 to 2004

Panel A: CS/Tremont hedge funds composite index

| N= 1Year | | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hedge fund | alpha | -0.54 | 1.94 | 0.08 | 0.03 | 0.01 | 0.19 | -0.20 | -0.05 | 0.15 | 0.90 | 0.29 |
| | t value | -0.94 | 1.87 | 0.09 | 0.04 | 0.01 | 0.44 | -0.54 | -0.30 | 0.75 | 3.27 | 1.36 |
| | significant | | * | | | | | | | | ** | |
| | Resquare | 0.36 | 0.41 | 0.57 | 0.75 | 0.42 | 0.86 | 0.93 | 0.69 | 0.55 | 0.42 | 0.72 |
| Fund of fund | alpha | -0.71 | 0.61 | 0.18 | -0.35 | -0.47 | 0.53 | -0.14 | -0.23 | 0.09 | 0.72 | |
| | t value | -1.83 | 0.82 | 0.44 | -0.71 | -0.59 | 2.01 | -0.42 | -1.47 | 0.61 | 2.53 | |
| | significant | | | | | | * | | | | ** | |
| | Resquare | 0.22 | 0.31 | 0.59 | 0.73 | 0.72 | 0.88 | 0.90 | 0.82 | 0.67 | 0.41 | |

| N= 3Year | | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hedge fund | alpha | 0.02 | 0.09 | -0.11 | 0.29 | 0.21 | 0.37 | 0.06 | 0.32 | 0.43 |
| | t value | 0.06 | 0.19 | -0.23 | 0.69 | 0.62 | 1.44 | 0.28 | 2.56 | 3.62 |
| | significant | | | | | | | | ** | *** |
| | Resquare | 0.35 | 0.43 | 0.47 | 0.47 | 0.62 | 0.67 | 0.69 | 0.47 | 0.53 |
| Fund of fund | alpha | -0.15 | -0.03 | -0.22 | 0.12 | 0.06 | 0.29 | -0.01 | 0.18 | |
| | t value | -0.63 | -0.10 | -0.92 | 0.48 | 0.30 | 1.65 | -0.06 | 1.49 | |
| | significant | | | | | | | | | |
| | Resquare | 0.37 | 0.49 | 0.66 | 0.66 | 0.76 | 0.74 | 0.70 | 0.48 | |

| N= 5Year | | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|
| Hedge fund | alpha | -0.05 | 0.35 | 0.37 | 0.31 | 0.22 | 0.41 | 0.24 |
| | t value | -0.16 | 1.08 | 1.26 | 1.16 | 0.93 | 2.35 | 1.77 |
| | significant | | | | | | ** | * |
| | Resquare | 0.40 | 0.40 | 0.51 | 0.49 | 0.50 | 0.61 | 0.65 |
| Fund of fund | alpha | -0.24 | 0.13 | 0.14 | 0.08 | 0.09 | 0.31 | |
| | t value | -1.34 | 0.70 | 0.86 | 0.48 | 0.61 | 2.41 | |
| | significant | | | | | | ** | |
| | Resquare | 0.55 | 0.58 | 0.69 | 0.66 | 0.63 | 0.64 | |

note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

Panel B: the asset-weight portfolio of TASS sample

| N= 1Year | | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hedge fund | alpha | -0.03 | 0.25 | 0.80 | 0.08 | -0.41 | 0.90 | 0.32 | 0.03 | 0.11 | 0.87 | 0.13 |
| | t value | -0.08 | 0.40 | 2.52 | 0.14 | -0.44 | 3.27 | 1.03 | 0.31 | 0.69 | 3.41 | 0.46 |
| | significant | | | ** | | | ** | | | | *** | |
| | Resquare | 0.50 | 0.36 | 0.62 | 0.68 | 0.66 | 0.89 | 0.92 | 0.91 | 0.73 | 0.52 | 0.61 |
| Fund of fund | alpha | -0.71 | 0.36 | 0.03 | -0.44 | -0.44 | 0.83 | 0.13 | -0.09 | 0.00 | 0.62 | 0.05 |
| | t value | -1.61 | 0.37 | 0.06 | -0.95 | -0.51 | 3.35 | 0.45 | -0.68 | 0.02 | 2.43 | 0.18 |
| | significant | | | | | | ** | | | | ** | |
| | Resquare | 0.55 | 0.24 | 0.51 | 0.69 | 0.58 | 0.87 | 0.90 | 0.67 | 0.50 | 0.29 | 0.61 |

| N= 3Year | | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| Hedge fund | alpha | 0.18 | 0.33 | 0.12 | 0.34 | 0.25 | 0.63 | 0.18 | 0.32 | 0.33 |
| | t value | 0.87 | 1.36 | 0.45 | 1.25 | 1.02 | 3.49 | 1.27 | 2.76 | 2.73 |
| | significant | | | | | | *** | | *** | ** |
| | Resquare | 0.47 | 0.52 | 0.62 | 0.64 | 0.71 | 0.75 | 0.76 | 0.60 | 0.58 |
| Fund of fund | alpha | -0.49 | -0.25 | -0.30 | 0.19 | 0.27 | 0.55 | 0.05 | 0.18 | 0.22 |
| | t value | -1.83 | -0.83 | -1.25 | 0.72 | 1.21 | 3.08 | 0.35 | 1.74 | 1.86 |
| | significant | * | | | | | *** | | * | * |
| | Resquare | 0.33 | 0.32 | 0.56 | 0.54 | 0.64 | 0.64 | 0.65 | 0.36 | 0.39 |

| N= 5Year | | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|
| Hedge fund | alpha | 0.05 | 0.36 | 0.41 | 0.31 | 0.25 | 0.55 | 0.27 |
| | t value | 0.28 | 1.93 | 2.37 | 1.69 | 1.48 | 4.25 | 2.46 |
| | significant | | * | ** | * | | *** | ** |
| | Resquare | 0.58 | 0.59 | 0.68 | 0.63 | 0.62 | 0.68 | 0.70 |
| Fund of fund | alpha | -0.45 | 0.05 | 0.22 | 0.21 | 0.22 | 0.44 | 0.14 |
| | t value | -2.24 | 0.22 | 1.27 | 1.23 | 1.37 | 3.52 | 1.31 |
| | significant | ** | | | | | *** | |
| | Resquare | 0.43 | 0.43 | 0.58 | 0.52 | 0.50 | 0.54 | 0.58 |

Panel C: The CS/Tremont hedge funds sub-sector indexes, sample window=12 month

| Year | | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Convertible | alpha | -0.98 | 0.67 | 0.92 | 0.43 | 0.51 | 0.96 | 2.16 | 0.75 | 0.28 | 1.18 | 0.00 |
| Arbitrage | t value | -3.04 | 1.41 | 8.24 | 1.39 | 0.43 | 4.37 | 4.97 | 2.91 | 0.60 | 2.19 | 0.02 |
| | significant | ** | | *** | | | *** | *** | ** | | * | |
| | Resquare | 0.07 | 0.08 | 0.16 | 0.42 | 0.34 | 0.23 | 0.43 | 0.04 | 0.22 | 0.05 | 0.07 |
| Dedicated Short | alpha | 0.53 | 1.90 | -0.02 | 1.38 | 1.67 | 0.12 | -1.44 | -1.54 | 0.15 | -1.90 | 0.20 |
| Bias | t value | 1.77 | 1.72 | -0.04 | 1.83 | 1.92 | 0.14 | -1.31 | -2.54 | 0.23 | -2.08 | 0.35 |
| | significant | | | | | * | | | ** | | * | |
| | Resquare | 0.94 | 0.80 | 0.91 | 0.89 | 0.97 | 0.77 | 0.89 | 0.90 | 0.83 | 0.49 | 0.88 |
| Emerging Markets | alpha | 1.61 | -1.72 | 1.72 | -1.69 | -5.40 | 0.95 | -0.60 | -0.43 | 0.98 | 1.33 | 0.29 |
| | t value | 0.94 | -0.62 | 1.56 | -0.86 | -2.11 | 0.65 | -0.73 | -0.80 | 1.99 | 2.98 | 0.54 |
| | significant | | | | | * | | | | * | * | |
| | Resquare | 0.51 | 0.23 | 0.16 | 0.49 | 0.69 | 0.59 | 0.86 | 0.83 | 0.66 | 0.65 | 0.51 |
| Equity Market | alpha | -0.49 | 0.66 | 0.67 | 0.33 | 0.42 | 0.90 | 0.96 | 0.40 | 0.48 | 0.38 | 0.21 |
| Neutral | t value | -2.34 | 1.18 | 4.49 | 0.65 | 1.40 | 5.84 | 4.50 | 2.01 | 2.90 | 2.13 | 0.95 |
| | significant | ** | | *** | | | *** | *** | * | * | * | |
| | Resquare | 0.22 | 0.14 | 0.53 | 0.59 | 0.75 | 0.53 | 0.52 | 0.23 | 0.30 | 0.12 | 0.31 |
| Event Driven | alpha | -0.05 | 0.49 | 1.07 | 0.34 | -1.02 | 1.12 | 0.35 | 0.22 | 0.04 | 1.28 | 0.69 |
| | t value | -0.16 | 1.51 | 4.00 | 1.25 | -0.79 | 5.18 | 2.65 | 1.09 | 0.11 | 4.68 | 3.05 |
| | significant | | | *** | | | *** | * | | | *** | ** |
| | Resquare | 0.61 | 0.61 | 0.47 | 0.80 | 0.71 | 0.77 | 0.92 | 0.74 | 0.64 | 0.16 | 0.68 |
| Fixed Income | alpha | -0.25 | 0.23 | 0.87 | 0.01 | 0.60 | 0.59 | -0.01 | 0.37 | 0.06 | 0.74 | 0.38 |
| Arbitrage | t value | -0.86 | 0.61 | 10.16 | 0.03 | 0.46 | 2.58 | -0.11 | 2.13 | 0.24 | 2.74 | 1.35 |
| | significant | | | *** | | | * | | * | | ** | |
| | Resquare | 0.25 | 0.28 | 0.16 | 0.32 | 0.24 | 0.14 | 0.32 | 0.34 | 0.62 | 0.23 | 0.11 |
| Global Macro | alpha | -0.69 | 3.65 | -0.43 | 0.43 | 0.78 | -1.11 | -0.66 | 0.84 | 0.94 | 1.45 | 0.38 |
| | t value | -0.82 | 1.93 | -0.32 | 0.36 | 0.27 | -1.22 | -0.62 | 2.51 | 3.68 | 2.68 | 1.20 |
| | significant | | * | | | | | | ** | *** | ** | |
| | Resquare | 0.19 | 0.31 | 0.59 | 0.70 | 0.21 | 0.64 | 0.45 | 0.32 | 0.14 | 0.10 | 0.22 |
| Long/Short Equity | alpha | -0.82 | 0.39 | 0.10 | -0.10 | 0.14 | 0.71 | -0.28 | -0.53 | -0.18 | 0.51 | 0.27 |
| Hedge | t value | -3.17 | 0.97 | 0.38 | -0.14 | 0.15 | 1.64 | -0.56 | -1.46 | -0.64 | 1.99 | 1.02 |
| | significant | ** | | | | | | | | | * | |
| | Resquare | 0.84 | 0.88 | 0.90 | 0.82 | 0.89 | 0.94 | 0.96 | 0.52 | 0.60 | 0.80 | 0.82 |
| Managed Futures | alpha | 0.48 | 0.88 | -0.22 | -2.48 | 0.93 | -0.92 | -1.83 | -0.84 | 0.43 | 1.63 | -0.87 |
| | t value | 1.27 | 0.29 | -0.26 | -2.38 | 0.49 | -1.12 | -1.39 | -0.95 | 0.41 | 0.89 | -0.72 |
| | significant | | | | * | | | | | | | |
| | Resquare | 0.54 | 0.08 | 0.48 | 0.64 | 0.28 | 0.31 | 0.33 | 0.69 | 0.54 | 0.09 | 0.43 |
| Multi-strategy | alpha | -0.14 | 0.50 | 1.16 | 0.21 | -1.27 | 0.91 | 0.71 | -0.06 | 0.12 | 1.10 | 0.57 |
| | t value | -0.37 | 0.76 | 4.05 | 0.71 | -0.89 | 4.21 | 2.23 | -0.20 | 0.38 | 4.44 | 2.02 |
| | significant | | | *** | | | *** | * | | | *** | * |
| | Resquare | 0.38 | 0.25 | 0.25 | 0.80 | 0.66 | 0.87 | 0.75 | 0.51 | 0.63 | 0.12 | 0.67 |

The CS/Tremont hedge funds sub-sector indexes, sample window=36 month

| Year | | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| Convertible | alpha | 0.10 | 0.72 | 0.19 | 0.28 | 0.50 | 1.04 | 0.83 | 0.56 | 0.33 |
| Arbitrage | t value | 0.49 | 5.11 | 0.71 | 1.05 | 1.66 | 6.29 | 3.47 | 2.56 | 1.53 |
| | significant | | *** | | | | *** | *** | ** | |
| | Resquare | 0.13 | 0.11 | 0.32 | 0.24 | 0.13 | 0.01 | 0.04 | 0.05 | 0.09 |
| Dedicated Short | alpha | 0.56 | 0.54 | 0.52 | 0.79 | 0.22 | -0.56 | -0.72 | -0.87 | -0.24 |
| Bias | t value | 2.01 | 1.31 | 1.54 | 1.88 | 0.47 | -1.18 | -1.54 | -2.26 | -0.61 |
| | significant | * | | | * | | | | ** | |
| | Resquare | 0.87 | 0.83 | 0.92 | 0.87 | 0.85 | 0.78 | 0.81 | 0.80 | 0.75 |
| Emerging Markets | alpha | -0.05 | -0.89 | -1.53 | -1.05 | -1.07 | 0.73 | 0.38 | 0.71 | 0.81 |
| | t value | -0.05 | -0.89 | -1.81 | -1.17 | -1.42 | 1.36 | 0.96 | 2.43 | 3.38 |
| | significant | | | * | | | | | ** | *** |
| | Resquare | 0.14 | 0.17 | 0.51 | 0.50 | 0.57 | 0.62 | 0.66 | 0.64 | 0.60 |
| Equity Market | alpha | 0.18 | 0.38 | 0.48 | 0.53 | 0.66 | 0.65 | 0.64 | 0.50 | 0.48 |
| Neutral | t value | 1.06 | 1.87 | 3.26 | 3.47 | 6.93 | 6.69 | 6.20 | 5.46 | 5.06 |
| | significant | | * | *** | *** | *** | *** | *** | *** | *** |
| | Resquare | 0.10 | 0.33 | 0.50 | 0.43 | 0.48 | 0.22 | 0.17 | 0.07 | 0.05 |
| Event Driven | alpha | 0.37 | 0.64 | -0.06 | 0.11 | 0.06 | 0.60 | 0.12 | 0.38 | 0.51 |
| | t value | 2.31 | 4.30 | -0.20 | 0.35 | 0.21 | 4.57 | 0.80 | 2.22 | 3.16 |
| | significant | * | *** | | | | *** | | ** | *** |
| | Resquare | 0.51 | 0.56 | 0.63 | 0.61 | 0.55 | 0.58 | 0.59 | 0.53 | 0.56 |
| Fixed Income | alpha | 0.21 | 0.42 | 0.01 | -0.03 | -0.14 | 0.34 | 0.17 | 0.37 | 0.38 |
| Arbitrage | t value | 1.45 | 2.95 | 0.04 | -0.10 | -0.50 | 3.68 | 1.19 | 2.38 | 2.70 |
| | significant | | *** | | | | *** | | ** | ** |
| | Resquare | 0.20 | 0.08 | 0.12 | 0.06 | 0.05 | 0.14 | 0.06 | 0.02 | 0.25 |
| Global Macro | alpha | 0.09 | 0.10 | -0.16 | 0.16 | -0.04 | 0.30 | 0.74 | 1.10 | 0.93 |
| | t value | 0.14 | 0.12 | -0.19 | 0.21 | -0.06 | 0.68 | 2.20 | 5.95 | 5.11 |
| | significant | | | | | | | * | *** | *** |
| | Resquare | 0.25 | 0.37 | 0.28 | 0.17 | 0.19 | 0.25 | 0.19 | 0.03 | 0.01 |
| Long/Short Equity | alpha | -0.21 | 0.03 | 0.31 | 0.73 | 1.02 | 0.69 | -0.27 | 0.00 | 0.27 |
| Hedge | t value | -1.23 | 0.12 | 1.22 | 2.59 | 3.42 | 1.59 | -0.80 | -0.01 | 1.73 |
| | significant | | | | ** | *** | | | | * |
| | Resquare | 0.83 | 0.83 | 0.86 | 0.87 | 0.88 | 0.68 | 0.69 | 0.56 | 0.66 |
| Managed Futures | alpha | 0.19 | -1.14 | 0.14 | 0.13 | 0.21 | -0.53 | 0.01 | 0.80 | 0.92 |
| | t value | 0.30 | -1.41 | 0.24 | 0.21 | 0.38 | -0.97 | 0.02 | 1.20 | 1.28 |
| | significant | | | | | | | | | |
| | Resquare | 0.02 | 0.14 | 0.20 | 0.03 | 0.06 | 0.15 | 0.31 | 0.24 | 0.06 |
| Multi-strategy | alpha | 0.37 | 0.52 | -0.18 | 0.01 | 0.08 | 0.61 | 0.18 | 0.29 | 0.50 |
| | t value | 1.73 | 2.38 | -0.55 | 0.04 | 0.25 | 3.70 | 1.10 | 1.77 | 3.23 |
| | significant | * | ** | | | | *** | | * | *** |
| | Resquare | 0.20 | 0.29 | 0.60 | 0.60 | 0.54 | 0.58 | 0.57 | 0.49 | 0.54 |

note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

The CS/Tremont hedge funds sub-sector indexes, sample window=60 month

| Year | | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|
| Convertible | alpha | 0.03 | 0.45 | 0.55 | 0.52 | 0.47 | 0.83 | 0.66 |
| Arbitrage | t value | 0.13 | 2.59 | 2.90 | 2.75 | 2.35 | 5.33 | 3.81 |
| | significant | | ** | *** | *** | ** | *** | *** |
| | Resquare | 0.25 | 0.21 | 0.14 | 0.12 | 0.10 | 0.02 | 0.02 |
| Dedicated Short | alpha | 0.60 | 0.69 | 0.48 | 0.06 | -0.25 | -0.58 | -0.63 |
| Bias | t value | 2.53 | 2.23 | 1.37 | 0.17 | -0.71 | -1.72 | -1.80 |
| | significant | ** | ** | | | | * | * |
| | Resquare | 0.91 | 0.85 | 0.83 | 0.80 | 0.81 | 0.77 | 0.78 |
| Emerging Markets | alpha | -1.09 | -1.02 | -0.50 | -0.58 | -0.25 | 0.88 | 0.45 |
| | t value | -1.50 | -1.50 | -0.88 | -1.04 | -0.48 | 2.50 | 1.71 |
| | significant | | | | | | ** | * |
| | Resquare | 0.33 | 0.38 | 0.51 | 0.51 | 0.49 | 0.59 | 0.65 |
| Equity Market | alpha | 0.24 | 0.49 | 0.61 | 0.59 | 0.62 | 0.60 | 0.55 |
| Neutral | t value | 1.83 | 4.25 | 6.24 | 5.80 | 7.80 | 8.20 | 6.98 |
| | significant | * | *** | *** | *** | *** | *** | *** |
| | Resquare | 0.30 | 0.32 | 0.40 | 0.34 | 0.23 | 0.10 | 0.10 |
| Event Driven | alpha | 0.02 | 0.28 | 0.27 | 0.24 | 0.19 | 0.52 | 0.42 |
| | t value | 0.09 | 1.41 | 1.38 | 1.16 | 0.91 | 4.44 | 3.54 |
| | significant | | | | | | *** | *** |
| | Resquare | 0.62 | 0.58 | 0.55 | 0.49 | 0.49 | 0.54 | 0.55 |
| Fixed Income | alpha | -0.01 | 0.22 | 0.10 | 0.00 | 0.00 | 0.36 | 0.32 |
| Arbitrage | t value | -0.03 | 1.13 | 0.55 | 0.00 | 0.01 | 3.55 | 2.94 |
| | significant | | | | | | *** | *** |
| | Resquare | 0.11 | 0.06 | 0.05 | 0.05 | 0.06 | 0.01 | 0.01 |
| Global Macro | alpha | 0.05 | 0.33 | 0.31 | 0.44 | 0.34 | 0.64 | 0.76 |
| | t value | 0.09 | 0.56 | 0.56 | 0.91 | 0.84 | 2.17 | 3.43 |
| | significant | | | | | | ** | *** |
| | Resquare | 0.21 | 0.18 | 0.18 | 0.12 | 0.12 | 0.16 | 0.16 |
| Long/Short Equity | alpha | 0.03 | 0.57 | 0.74 | 0.66 | 0.66 | 0.51 | -0.01 |
| Hedge | t value | 0.18 | 2.92 | 3.52 | 2.25 | 2.19 | 1.80 | -0.02 |
| | significant | | *** | *** | ** | ** | * | |
| | Resquare | 0.84 | 0.84 | 0.86 | 0.72 | 0.67 | 0.63 | 0.68 |
| Managed Futures | alpha | 0.20 | -0.06 | 0.08 | 0.11 | 0.30 | 0.21 | 0.39 |
| | t value | 0.41 | -0.13 | 0.19 | 0.25 | 0.70 | 0.44 | 0.71 |
| | significant | | | | | | | |
| | Resquare | 0.08 | 0.02 | 0.03 | 0.05 | 0.21 | 0.13 | 0.09 |
| Multi-strategy | alpha | -0.10 | 0.15 | 0.28 | 0.16 | 0.14 | 0.53 | 0.41 |
| | t value | -0.42 | 0.65 | 1.28 | 0.71 | 0.62 | 4.32 | 3.32 |
| | significant | | | | | | *** | *** |
| | Resquare | 0.49 | 0.51 | 0.53 | 0.49 | 0.46 | 0.55 | 0.54 |

note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

Panel D: Asset-weight portfolio of TASS sample, sample window=12 month

| Year | | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Convertible | alpha | -1.00 | 1.09 | 0.86 | 0.62 | 0.35 | 0.86 | 1.57 | 0.80 | 0.65 | 1.13 | -0.06 |
| Arbitrage | t value | -1.94 | 3.96 | 6.63 | 3.23 | 0.32 | 2.87 | 4.94 | 2.25 | 2.59 | 2.49 | -0.15 |
| | significant | * | *** | *** | ** | | ** | *** | * | ** | ** | |
| | Resquare | 0.13 | 0.02 | 0.31 | 0.33 | 0.31 | 0.24 | 0.50 | 0.06 | 0.30 | 0.05 | 0.18 |
| Dedicated Short | alpha | 0.48 | -0.19 | 0.56 | 1.58 | 1.68 | 0.01 | -1.62 | -1.02 | 0.77 | 0.41 | -0.06 |
| Bias | t value | 1.24 | -0.18 | 0.93 | 2.03 | 1.89 | 0.01 | -1.33 | -2.52 | 1.85 | 1.20 | -0.13 |
| | significant | | | | * | * | | | ** | | | |
| | Resquare | 0.88 | 0.56 | 0.85 | 0.89 | 0.97 | 0.83 | 0.86 | 0.96 | 0.92 | 0.96 | 0.89 |
| Emerging Markets | alpha | 0.86 | -0.76 | 1.21 | -1.07 | -5.96 | 1.58 | -0.47 | 0.62 | 1.26 | 1.89 | 0.69 |
| | t value | 0.79 | -0.44 | 1.31 | -0.51 | -2.18 | 1.24 | -0.53 | 1.23 | 2.31 | 3.16 | 0.91 |
| | significant | | | | | * | | | | ** | ** | |
| | Resquare | 0.59 | 0.24 | 0.20 | 0.39 | 0.70 | 0.68 | 0.77 | 0.88 | 0.68 | 0.56 | 0.42 |
| Equity Market | alpha | -0.04 | 0.10 | 0.94 | 0.72 | 0.45 | 0.47 | 0.62 | 0.14 | 0.28 | 0.24 | 0.05 |
| Neutral | t value | -0.20 | 0.28 | 6.87 | 2.46 | 1.99 | 2.85 | 3.90 | 0.95 | 2.04 | 2.07 | 0.41 |
| | significant | | | *** | ** | * | ** | *** | | * | * | |
| | Resquare | 0.25 | 0.39 | 0.47 | 0.54 | 0.74 | 0.34 | 0.66 | 0.08 | 0.13 | 0.23 | 0.74 |
| Event Driven | alpha | 0.48 | 0.98 | 1.37 | 0.51 | -0.39 | 1.05 | 0.61 | 0.15 | 0.13 | 1.24 | 0.50 |
| | t value | 1.19 | 1.30 | 4.07 | 1.90 | -0.44 | 6.01 | 2.94 | 0.89 | 0.44 | 5.08 | 2.64 |
| | significant | | | *** | * | | *** | ** | | | *** | ** |
| | Resquare | 0.66 | 0.38 | 0.33 | 0.58 | 0.72 | 0.62 | 0.71 | 0.73 | 0.58 | 0.30 | 0.75 |
| Fixed Income | alpha | -0.43 | 0.39 | 1.37 | 0.29 | 0.93 | 0.77 | 0.43 | 0.40 | 0.19 | 0.93 | 0.38 |
| Arbitrage | t value | -1.07 | 0.79 | 15.64 | 0.94 | 0.60 | 3.06 | 2.19 | 1.63 | 0.78 | 3.28 | 1.39 |
| | significant | | | *** | | | ** | * | | | ** | |
| | Resquare | 0.24 | 0.22 | 0.36 | 0.33 | 0.28 | 0.09 | 0.22 | 0.35 | 0.62 | 0.40 | 0.13 |
| Global Macro | alpha | -0.12 | -0.09 | 0.96 | 1.53 | 0.46 | -1.10 | 0.16 | -0.41 | -0.14 | 1.50 | -0.26 |
| | t value | -0.10 | -0.06 | 1.78 | 1.73 | 0.28 | -2.40 | 0.18 | -0.70 | -0.47 | 2.66 | -0.50 |
| | significant | | | | | | ** | | | | ** | |
| | Resquare | 0.21 | 0.28 | 0.18 | 0.04 | 0.28 | 0.47 | 0.08 | 0.50 | 0.59 | 0.21 | 0.30 |
| Long/Short Equity | alpha | -0.40 | 0.73 | 0.44 | 0.39 | 0.45 | 1.45 | 0.13 | -0.27 | -0.31 | 0.41 | 0.14 |
| Hedge | t value | -1.05 | 3.40 | 1.49 | 0.52 | 0.54 | 3.71 | 0.22 | -1.17 | -1.51 | 1.66 | 0.42 |
| | significant | | *** | | | | *** | | | | | |
| | Resquare | 0.59 | 0.94 | 0.91 | 0.81 | 0.86 | 0.94 | 0.92 | 0.88 | 0.80 | 0.84 | 0.74 |
| Managed Futures | alpha | -0.98 | 0.31 | -0.71 | -1.56 | 1.18 | -0.57 | -0.82 | -0.32 | 0.42 | 1.00 | -0.85 |
| | t value | -1.87 | 0.20 | -0.70 | -1.48 | 0.68 | -0.69 | -0.67 | -0.35 | 0.43 | 0.56 | -0.87 |
| | significant | * | | | | | | | | | | |
| | Resquare | 0.54 | 0.02 | 0.43 | 0.60 | 0.41 | 0.30 | 0.25 | 0.67 | 0.55 | 0.06 | 0.39 |
| Multi-strategy | alpha | 0.18 | 0.72 | 0.39 | -0.17 | -0.18 | 1.79 | 1.54 | 0.28 | 0.34 | 1.13 | 0.45 |
| | t value | 0.54 | 1.09 | 1.28 | -0.50 | -0.17 | 6.52 | 4.17 | 1.35 | 1.70 | 4.26 | 1.92 |
| | significant | | | | | | *** | *** | | | *** | * |
| | Resquare | 0.44 | 0.03 | 0.20 | 0.69 | 0.52 | 0.50 | 0.76 | 0.57 | 0.60 | 0.11 | 0.50 |

note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

Asset-weight portfolio of TASS sample, sample window=36 month

| Year | | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| Convertible | alpha | 0.08 | 0.87 | 0.36 | 0.45 | 0.57 | 0.93 | 0.83 | 0.73 | 0.46 |
| Arbitrage | t value | 0.35 | 9.48 | 1.58 | 1.95 | 2.33 | 5.98 | 4.91 | 4.31 | 2.57 |
| | significant | | *** | | * | ** | *** | *** | *** | ** |
| | Resquare | 0.15 | 0.13 | 0.30 | 0.26 | 0.20 | 0.07 | 0.07 | 0.01 | 0.06 |
| Dedicated Short | alpha | 0.58 | 0.57 | 0.88 | 0.76 | -0.12 | -0.69 | -0.43 | -0.15 | 0.15 |
| Bias | t value | 1.99 | 1.51 | 2.61 | 2.03 | -0.26 | -1.68 | -1.07 | -0.59 | 0.68 |
| | significant | * | | ** | * | | | | | |
| | Resquare | 0.78 | 0.81 | 0.91 | 0.89 | 0.86 | 0.84 | 0.85 | 0.91 | 0.91 |
| Emerging Markets | alpha | -0.06 | -0.32 | -1.60 | -0.99 | -1.15 | 1.15 | 0.80 | 1.17 | 1.08 |
| | t value | -0.10 | -0.41 | -1.88 | -1.08 | -1.43 | 2.16 | 1.89 | 3.70 | 3.58 |
| | significant | | | * | | | ** | * | *** | *** |
| | Resquare | 0.23 | 0.21 | 0.54 | 0.54 | 0.56 | 0.61 | 0.61 | 0.65 | 0.55 |
| Equity Market | alpha | 0.40 | 0.60 | 0.63 | 0.52 | 0.42 | 0.37 | 0.36 | 0.28 | 0.28 |
| Neutral | t value | 2.90 | 4.17 | 6.20 | 5.11 | 5.18 | 4.23 | 4.33 | 4.09 | 3.74 |
| | significant | *** | *** | *** | *** | *** | *** | *** | *** | *** |
| | Resquare | 0.06 | 0.25 | 0.46 | 0.42 | 0.40 | 0.06 | 0.15 | 0.00 | 0.05 |
| Event Driven | alpha | 0.77 | 1.02 | 0.35 | 0.31 | 0.27 | 0.57 | 0.22 | 0.43 | 0.51 |
| | t value | 3.25 | 4.48 | 1.44 | 1.41 | 1.21 | 5.43 | 1.67 | 3.03 | 3.81 |
| | significant | *** | *** | | | | *** | | *** | *** |
| | Resquare | 0.43 | 0.26 | 0.58 | 0.58 | 0.50 | 0.50 | 0.53 | 0.51 | 0.57 |
| Fixed Income | alpha | 0.29 | 0.75 | 0.22 | 0.07 | -0.03 | 0.56 | 0.31 | 0.39 | 0.35 |
| Arbitrage | t value | 1.45 | 4.43 | 0.57 | 0.19 | -0.09 | 5.15 | 2.19 | 2.48 | 2.54 |
| | significant | | *** | | | | *** | ** | ** | ** |
| | Resquare | 0.19 | 0.03 | 0.12 | 0.05 | 0.05 | 0.16 | 0.18 | 0.14 | 0.32 |
| Global Macro | alpha | 0.35 | 1.14 | 0.67 | 0.20 | -0.29 | -0.21 | -0.01 | 0.33 | 0.30 |
| | t value | 0.67 | 2.42 | 1.53 | 0.46 | -0.73 | -0.62 | -0.04 | 1.16 | 1.22 |
| | significant | | * | | | | | | | |
| | Resquare | 0.06 | 0.07 | 0.09 | 0.10 | 0.06 | 0.07 | 0.08 | 0.25 | 0.30 |
| Long/Short Equity | alpha | 0.18 | 0.34 | 0.50 | 0.98 | 0.93 | 0.93 | -0.12 | 0.00 | 0.10 |
| Hedge | t value | 1.02 | 1.47 | 1.91 | 3.23 | 3.08 | 2.53 | -0.45 | 0.00 | 0.66 |
| | significant | | | * | *** | *** | ** | | | |
| | Resquare | 0.78 | 0.84 | 0.82 | 0.82 | 0.84 | 0.75 | 0.77 | 0.74 | 0.73 |
| Managed Futures | alpha | -0.25 | -0.78 | 0.20 | 0.52 | 0.49 | -0.05 | 0.34 | 0.84 | 0.69 |
| | t value | -0.54 | -1.41 | 0.33 | 0.88 | 0.95 | -0.09 | 0.59 | 1.30 | 1.05 |
| | significant | | | | | | | | | |
| | Resquare | 0.15 | 0.35 | 0.19 | 0.04 | 0.13 | 0.19 | 0.35 | 0.24 | 0.08 |
| Multi-strategy | alpha | 0.43 | 0.29 | -0.17 | 0.41 | 0.57 | 1.05 | 0.56 | 0.46 | 0.50 |
| | t value | 2.11 | 1.43 | -0.69 | 1.42 | 1.94 | 6.00 | 3.37 | 3.76 | 4.14 |
| | significant | ** | | | | * | *** | *** | *** | *** |
| | Resquare | 0.05 | 0.27 | 0.50 | 0.43 | 0.38 | 0.50 | 0.44 | 0.40 | 0.40 |

note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

Asset-weight portfolio of TASS sample, sample window=60 month

| Year | | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|
| Convertible Arbitrage | alpha | 0.12 | 0.58 | 0.60 | 0.61 | 0.61 | 0.84 | 0.67 |
| | t value | 0.66 | 3.93 | 3.96 | 3.77 | 3.75 | 6.97 | 4.67 |
| | significant | | *** | *** | *** | *** | *** | *** |
| | Resquare | 0.21 | 0.23 | 0.19 | 0.13 | 0.13 | 0.06 | 0.04 |
| Dedicated Short Bias | alpha | 0.75 | 0.67 | 0.42 | 0.00 | -0.24 | -0.35 | -0.30 |
| | t value | 3.13 | 2.47 | 1.28 | 0.00 | -0.76 | -1.28 | -1.12 |
| | significant | *** | ** | | | | | |
| | Resquare | 0.89 | 0.87 | 0.83 | 0.83 | 0.85 | 0.85 | 0.87 |
| Emerging Markets | alpha | -1.12 | -0.88 | -0.64 | -0.45 | -0.01 | 1.24 | 0.85 |
| | t value | -1.87 | -1.41 | -1.11 | -0.77 | -0.02 | 3.42 | 2.85 |
| | significant | * | | | | | *** | *** |
| | Resquare | 0.45 | 0.46 | 0.50 | 0.50 | 0.47 | 0.56 | 0.59 |
| Equity Market Neutral | alpha | 0.44 | 0.53 | 0.55 | 0.44 | 0.38 | 0.36 | 0.32 |
| | t value | 4.58 | 6.21 | 7.56 | 5.88 | 5.86 | 5.92 | 5.01 |
| | significant | *** | *** | *** | *** | *** | *** | *** |
| | Resquare | 0.26 | 0.28 | 0.37 | 0.27 | 0.16 | 0.05 | 0.09 |
| Event Driven | alpha | 0.48 | 0.64 | 0.51 | 0.35 | 0.28 | 0.54 | 0.44 |
| | t value | 2.55 | 3.68 | 3.24 | 2.37 | 1.90 | 5.55 | 4.32 |
| | significant | ** | *** | *** | ** | * | *** | *** |
| | Resquare | 0.53 | 0.49 | 0.46 | 0.47 | 0.46 | 0.48 | 0.52 |
| Fixed Income Arbitrage | alpha | 0.08 | 0.42 | 0.30 | 0.12 | 0.06 | 0.47 | 0.37 |
| | t value | 0.32 | 1.76 | 1.33 | 0.58 | 0.30 | 4.54 | 3.40 |
| | significant | | * | | | | *** | *** |
| | Resquare | 0.11 | 0.06 | 0.04 | 0.05 | 0.06 | 0.10 | 0.09 |
| Global Macro | alpha | 0.42 | 0.34 | 0.24 | 0.08 | -0.21 | 0.08 | 0.21 |
| | t value | 1.07 | 1.00 | 0.82 | 0.27 | -0.76 | 0.36 | 0.86 |
| | significant | | | | | | | |
| | Resquare | 0.05 | 0.04 | 0.06 | 0.05 | 0.07 | 0.14 | 0.13 |
| Long/Short Equity Hedge | alpha | 0.31 | 0.80 | 0.84 | 0.72 | 0.57 | 0.62 | 0.01 |
| | t value | 1.73 | 4.06 | 3.97 | 2.79 | 2.29 | 2.49 | 0.07 |
| | significant | * | *** | *** | *** | ** | ** | |
| | Resquare | 0.79 | 0.82 | 0.84 | 0.75 | 0.72 | 0.70 | 0.76 |
| Managed Futures | alpha | 0.06 | 0.31 | 0.33 | 0.51 | 0.50 | 0.44 | 0.45 |
| | t value | 0.15 | 0.72 | 0.76 | 1.18 | 1.29 | 1.00 | 0.91 |
| | significant | | | | | | | |
| | Resquare | 0.16 | 0.05 | 0.03 | 0.08 | 0.28 | 0.15 | 0.13 |
| Multi-strategy | alpha | 0.09 | 0.38 | 0.43 | 0.46 | 0.52 | 0.86 | 0.59 |
| | t value | 0.46 | 1.95 | 2.21 | 2.39 | 2.77 | 6.83 | 5.04 |
| | significant | | * | ** | ** | *** | *** | *** |
| | Resquare | 0.33 | 0.36 | 0.37 | 0.36 | 0.35 | 0.41 | 0.41 |

note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

Table A2: Alpha difference between the CS/Tremont and the value-weight portfolio of TASS sample

| Time | Hedge fund | Convertible Arbitrage | Dedicated Short Bias | Emerging Markets | Equity Market Neutral | Event Driven | Fixed Income Arbitrage | Global Macro | Long/Short Equity Hedge | Managed Futures | Multi-strategy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dec-02 | 0.032 | 0.141 | 0.015 | 0.237 | -0.239 | 0.095 | 0.061 | -0.549 | -0.086 | 0.205 | 0.378 |
| Jan-03 | 0.043 | 0.129 | 0.088 | 0.289 | -0.235 | 0.094 | 0.067 | -0.550 | -0.079 | 0.198 | 0.360 |
| Feb-03 | 0.042 | 0.126 | 0.152 | 0.309 | -0.231 | 0.086 | 0.071 | -0.493 | -0.076 | 0.187 | 0.346 |
| Mar-03 | 0.089 | 0.111 | 0.119 | 0.301 | -0.229 | 0.087 | 0.078 | -0.418 | -0.063 | 0.176 | 0.372 |
| Apr-03 | 0.090 | 0.110 | 0.105 | 0.322 | -0.230 | 0.092 | 0.072 | -0.425 | -0.078 | 0.185 | 0.373 |
| May-03 | 0.127 | 0.110 | 0.117 | 0.352 | -0.230 | 0.090 | 0.058 | -0.407 | -0.068 | 0.192 | 0.360 |
| Jun-03 | 0.182 | 0.115 | 0.209 | 0.386 | -0.243 | 0.076 | 0.066 | -0.365 | 0.023 | 0.208 | 0.324 |
| Jul-03 | 0.218 | 0.107 | 0.162 | 0.374 | -0.249 | 0.087 | 0.055 | -0.309 | 0.085 | 0.221 | 0.327 |
| Aug-03 | 0.208 | 0.107 | 0.170 | 0.411 | -0.246 | 0.030 | 0.048 | -0.397 | 0.021 | 0.191 | 0.269 |
| Sep-03 | 0.196 | 0.115 | 0.184 | 0.420 | -0.252 | -0.003 | 0.066 | -0.414 | 0.044 | 0.227 | 0.237 |
| Oct-03 | 0.146 | 0.051 | 0.196 | 0.415 | -0.228 | -0.001 | 0.107 | -0.533 | 0.070 | 0.266 | 0.305 |
| Nov-03 | 0.128 | 0.042 | 0.202 | 0.413 | -0.224 | -0.003 | 0.101 | -0.566 | 0.081 | 0.238 | 0.307 |
| Dec-03 | 0.145 | 0.016 | 0.229 | 0.361 | -0.245 | 0.018 | 0.114 | -0.551 | 0.107 | 0.234 | 0.331 |
| Jan-04 | 0.116 | 0.018 | 0.248 | 0.334 | -0.239 | 0.024 | 0.110 | -0.626 | 0.108 | 0.199 | 0.330 |
| Feb-04 | 0.091 | 0.014 | 0.233 | 0.377 | -0.227 | 0.013 | 0.098 | -0.680 | 0.088 | 0.095 | 0.296 |
| Mar-04 | 0.065 | 0.008 | 0.303 | 0.435 | -0.207 | 0.019 | 0.101 | -0.721 | 0.073 | 0.125 | 0.308 |
| Apr-04 | 0.047 | -0.004 | 0.227 | 0.435 | -0.190 | 0.006 | 0.099 | -0.717 | 0.063 | 0.152 | 0.273 |
| May-04 | 0.027 | -0.004 | 0.191 | 0.404 | -0.190 | 0.010 | 0.087 | -0.721 | 0.025 | 0.140 | 0.268 |
| Jun-04 | 0.021 | 0.002 | 0.203 | 0.314 | -0.189 | 0.031 | 0.091 | -0.684 | 0.004 | 0.144 | 0.264 |

Table A3: Significant results for Variance test between the CS/Tremont and the value-weight portfolio of TASS sample in each scenario.

| Strategyt ype | Scenario Group | INDEX | T-Tests | | Equality of Variances | | |
|---|---|---|---|---|---|---|---|
| | | | Mean | t Value | Std Dev | F Value | p-value |
| Equity Market Neutı | 4 | TASS sample | 0.874 | | 0.735 | | |
| Equity Market Neutı | 4 | CS/Tremont | 0.840 | | 1.045 | | |
| Equity Market Neutı | 4 | Difference | 0.031 | 0.120 | 0.903 | 2.020 | 0.092 |
| Global Macro | 1 | TASS sample | -0.446 | | 1.804 | | |
| Global Macro | 1 | CS/Tremont | -0.813 | | 2.870 | | |
| Global Macro | 1 | Difference | 0.368 | 0.560 | 2.397 | 2.530 | 0.021 |
| Global Macro | 3 | TASS sample | 1.057 | | 1.487 | | |
| Global Macro | 3 | CS/Tremont | 1.071 | | 2.426 | | |
| Global Macro | 3 | Difference | -0.015 | -0.030 | 2.012 | 2.660 | 0.017 |
| Global Macro | 5 | TASS sample | 1.053 | | 2.511 | | |
| Global Macro | 5 | CS/Tremont | 2.257 | | 4.742 | | |
| Global Macro | 5 | Difference | -1.204 | -1.170 | 3.794 | 3.560 | 0.002 |
| Hedge fund | 4 | TASS sample | 1.584 | | 1.258 | | |
| Hedge fund | 4 | CS/Tremont | 1.709 | | 1.792 | | |
| Hedge fund | 4 | Difference | -0.125 | -0.290 | 1.548 | 2.030 | 0.090 |
| Hedge fund | 5 | TASS sample | 1.817 | | 1.902 | | |
| Hedge fund | 5 | CS/Tremont | 2.219 | | 2.801 | | |
| Hedge fund | 5 | Difference | -0.401 | -0.620 | 2.394 | 2.170 | 0.053 |
| Managed Futures | 4 | TASS sample | 0.191 | | 2.563 | | |
| Managed Futures | 4 | CS/Tremont | 0.027 | | 3.785 | | |
| Managed Futures | 4 | Difference | 0.164 | 0.180 | 3.233 | 2.180 | 0.062 |
| Multi-strategy | 1 | TASS sample | 0.093 | | 1.729 | | |
| Multi-strategy | 1 | CS/Tremont | -0.395 | | 2.485 | | |
| Multi-strategy | 1 | Difference | 0.489 | 0.840 | 2.141 | 2.060 | 0.070 |

Table A3: Test for Variance between CS/Tremont and the value-weight portfolio of TASS sample during 1994 to 2004

| Strategyt ype | INDEX | T-Tests | | Equality of Variances | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | t Value | Std Dev | F Value | p-value | |
| Convertible Arbitrage | TASS sample | 0.851 | | 1.248 | | | |
| | CS/Tremont | 0.783 | | 1.352 | | | |
| | Difference | 0.068 | 0.420 | 1.301 | 1.170 | 0.365 | |
| Dedicated Short Bias | TASS sample | -0.069 | | 4.831 | | | |
| | CS/Tremont | -0.143 | | 5.102 | | | |
| | Difference | 0.074 | 0.120 | 4.968 | 1.120 | 0.534 | |
| Emerging Markets | TASS sample | 0.937 | | 4.675 | | | |
| | CS/Tremont | 0.728 | | 4.936 | | | |
| | Difference | 0.209 | 0.350 | 4.807 | 1.120 | 0.536 | |
| Equity Market Neutral | TASS sample | 0.756 | | 0.672 | | | |
| | CS/Tremont | 0.821 | | 0.874 | | | |
| | Difference | -0.065 | -0.680 | 0.780 | 1.690 | 0.003 | *** |
| Event Driven | TASS sample | 1.067 | | 1.454 | | | |
| | CS/Tremont | 0.929 | | 1.689 | | | |
| | Difference | 0.138 | 0.710 | 1.576 | 1.350 | 0.090 | * |
| Fixed Income Arbitrage | TASS sample | 0.648 | | 1.352 | | | |
| | CS/Tremont | 0.556 | | 1.111 | | | |
| | Difference | 0.092 | 0.600 | 1.237 | 1.480 | 0.026 | ** |
| Global Macro | TASS sample | 0.706 | | 2.275 | | | |
| | CS/Tremont | 1.151 | | 3.359 | | | |
| | Difference | -0.445 | -1.260 | 2.869 | 2.180 | <.0001 | *** |
| Long/Short Equity Hedge | TASS sample | 1.064 | | 2.879 | | | |
| | CS/Tremont | 0.991 | | 3.069 | | | |
| | Difference | 0.074 | 0.200 | 2.975 | 1.140 | 0.467 | |
| Managed Futures | TASS sample | 0.717 | | 3.210 | | | |
| | CS/Tremont | 0.624 | | 3.536 | | | |
| | Difference | 0.093 | 0.220 | 3.376 | 1.210 | 0.271 | |
| Hedge funds | TASS sample | 0.832 | | 1.746 | | | |
| | CS/Tremont | 0.894 | | 2.360 | | | |
| | Difference | -0.062 | -0.240 | 2.076 | 1.830 | 0.001 | *** |
| Multi-strategy | TASS sample | 0.894 | | 1.378 | | | |
| | CS/Tremont | 0.849 | | 1.786 | | | |
| | Difference | 0.045 | 0.230 | 1.595 | 1.680 | 0.003 | *** |
| fund of fund | TASS sample | 0.539 | | 1.592 | | | |
| | CS/Tremont | 0.623 | | 1.671 | | | |
| | Difference | -0.084 | -0.420 | 1.632 | 1.100 | 0.580 | |

note: *** is significant at 1% level, ** is significant at 5% level and * is significant at 10% level

# Survival analysis in the hedge fund and its application to fund selection

## 1. Introduction

Whether because of industrial competition, investors' requirements or the uncertainty of the financial markets, the survival conditions of hedge funds are more severe than ever before. Moreover, hedge funds are required to have more transparency and disclosure by supervision after the recent financial disaster. Consequently, successful managers have to adjust their trading behavior to adapt to the changes of the external environment and lifecycle. In addition, good managers have a distinct consideration and behavior in terms of a new lifecycle position and matching investors' demand for a different style of strategy. According to the concept of a natural selection and the survival of the fittest, only successful hedge funds can survive under intense competition. Therefore, observing the dynamic behavior and characteristics of the fittest hedge funds is a good way to perceive the key factors for survival. After all, the market is always correct and only the winners can tell us why they have survived and explain the difference between them and failed funds. Therefore, it will be appropriate to detect the key to survival by means of analyzing successful funds. Moreover, this is meaningful for investors, in that understanding the key factors for survival helps investors to screen failed funds, which prevents them from holding on to them and incurring huge losses.

If we want to observe the behavior of successful funds, we need to consider which of the required conditions of successful funds should be possessed first. Long track records and the basic threshold of size should be held by intuition. Firstly, enough of a track record can ensure that it has experienced the knockout of the industry and unexpected market shocks, such as the financial crisis, or the technology bubble. In addition, funds with a long track record are not only representative, but can also reflect a more complete dynamic behavior during a different lifecycle period. Secondly, achieving the survival of the threshold of the size can assure funds to keep stable revenues to cover fixed costs of operating, and provide the stake for developing know-how and human resources. The scale of AUM also represents investors' response to the degree of confidence in managers, and investors generally invest their money in potential funds after careful evaluation. Thus, if funds with a long record and a growing scale, have survived until now, they must have some worthwhile key or characteristic for survival. Moreover, the

different trading styles should be separated for observation, because investors have different focuses on requirements according to their risk attributes.

We aim to find the key to the survival of the fittest by way of observing the difference between groups of successful funds and other live or defunct funds. In consideration of the right censoring[1] for survival data, we use the survival analysis to test whether these factors are good predictor variables related to hedge funds' survival. Besides, we hope to use simple indicators of survival to select the funds which provide a better performance and a low attrition over the next two years. This can be the first checkpoint for selecting potential targets before due diligence, and can avoid choosing funds which have encountered large losses to be liquidated or closed.

In terms of the relevant sentiments of the surviving factors from hedge funds' literature, Lo (2001, 2005) points out three factors which affect the survival of hedge funds, the first of which is the well-developed system of risk management, which can increase a fund's alpha and lessen its risks simultaneously. He also demonstrates that, by means of carrying out a loss limitation, the expected returns can be raised and the volatility lowered. The second is the complete investment process, which is determined by the risk preferences of both investors and managers, adjusting the trading strategy, and dynamic risk exposure. The last element is the key to survival, namely innovation. Because the risk/reward relationship varies over time, managers need to create more innovation to achieve stable expected returns under changing market conditions. Barton Biggs (2006) emphasizes the fact that performance dominates funds' survival in practice, and absolute performance is far more important than relative performance, especially for new funds. Besides, the timing for executing stop loss and the present position of incentives for managers[2] also affect the good operation of the funds.

Empirical studies generally propose three methods to cause the reasons for the attrition (i.e. survival) of hedge funds, the first of which is the comparison of the attrition rate of each group divided by specific characteristics. Amin and Kat (2003)

[1] If the lifetimes are known only to exceed given observational time, it is referred to as right censoring. The observations that are censored in this way are called to singly type I censored.

[2] For example, the senior managers who have fame and enough wealth may lack the active motivation to do innovations or chase high performance. They just maintain the performance as same as industry and tend to obey the principle "The less you do the fewer mistakes you make". In contrast with junior managers, they have heavy pressure of survival and creating reputation.

point out that lack of size, performance and an aggressive attitude of manager can result in a high attrition rate of hedge funds.

The second method is adopting a survival analysis, such as the Cox's Proportional Hazards model, the Kaplan-Meier method and the Accelerated Failure Time model, to illustrate the factors which affect the hazard rate and survival function of hedge funds. Brown, Goetzmann and Park (2001) firstly used the Cox model to analyze fund failure and demonstrated that the survival of hedge funds mainly depends upon relative and absolute performance, and excess volatility and seasoning, which indicates that the older funds are more likely to survive. However, they found that the relative performance was more important than the absolute performance because only having a good ranking among the same-style competitors could guarantee that funds would still survive the next contest. In addition, managers would take into account the cost of their reputation and their careers to make the right choice of risk under the contractual frame of asymmetric reward. The major reason is that the punishment cost of high volatility resulting in fund termination is more expensive than the incentive revenues of high volatility in the short-term. Boyson (2002) also finds that more-senior risk-taking managers have a significantly higher probability of failure than less-senior ones. Bares, Gibson and Gyger (2001) use the Kaplan-Meier method and find that investment styles, size, beta and style inconsistency can significantly affect the probability of survival. In addition to previous factors, Gregoriou (2002) illustrates that the lockup period, the incentive fee, leverage, and minimum purchase also affect the mortality of funds, and Park (2007) proposes that downside risk measures in consideration of higher moments are better predictor variables of the survival function than standard deviation.[3]

The last method is running a probit or logistic regression to explain the reasons affecting the probability of liquidation. Liang (2000) uses monthly data and finds that poor performance, low assets, low incentive fees, high leverage, young age, and low manager personal investment raises the risk of the death of hedge funds. Getmansky, Lo and Mei (2004) report that historical performance, volatility and investment style, influence the survival rate of hedge funds, and some authors use quarter data to analyze the factors of

[3] The funds with high downside risk have a significantly high hazard rate under controlling the others variables such as style, performance, size, age, lockup, high-water mark and leverage. In contrast with the standard deviation, it loses the explanatory power for hazard function when the other explanatory variables are contained.

liquidation. Malkiel and Saha (2004) demonstrate that high volatility and poor performance are strong predictors of death. Chan, Getmansky, Lo and Hass (2005) point out that poor recent performance, small size, young age and the outflow of funds increase the risk of fund liquidation under a controlling style and a calendar effect. In addition, Getmansky (2005) takes account of industrial competition and lifecycles to illustrate categorical competition due to the fact that increasing favoritism by investors raises the probability of fund liquidation. Baquero, Horst and Verbeek (2005) achieve consistent results with prior research, in which age[4], AUM (assets under management), cumulative return, and flows could have a significantly negative impact upon the probability of liquidation.

Next we briefly review the literature about the survival time of hedge funds. Brown, Goetzmann and Park (2001) find that half life of hedge funds survive 30 months and half of CTAs survive for 24 months. Bares, Gibson and Gyger (2001) claim that 70% of the hedge funds on the FRM database can survive for 80 months and half of them survive for 10 years, which is much higher than the findings of other studies. Howell (2001) observes that the probability of hedge funds failing in the first year was 0.074, only to increase to 0.203 in the second year. Amin and Kat (2003) discover that more than 40% of the TASS hedge funds do not survive for five years, and Gregoriou (2002) reports that the median survival times of the individual hedge fund and the fund of funds on the Zurich database is 5.5 and 7.5 years respectively. Rough (2005) indicates that the expected lifetime of large funds and small funds on the HFR database is 7.47 years and 5.37 years, respectively. Table 1 illustrates a summary of the empirical results of the attrition rate of hedge funds. The estimations of the attrition rates range from 2% to 15%, and this difference comes from using different databases and time periods.

Firstly, this study investigates the key to survival of the fittest by proper grouping, and discusses several dimensions of the survival, according to prior literature and the specialties of leading funds, which have at least a five year track record, and the top five US dollar assets under management (i.e. AUM) in each investment style at the end of 2004. We regard the leading funds as being successful funds, which could manage enormous assets and are still alive today. They should have more competitive strengths

[4] They find that there exist negative nonlinear relation between age and liquidated probability. The younger funds are likely easier to disappear than older those.

than others because of having passed many severe tests by giving in to the market and investors. The foregoing viewpoints from literature may be summed up by several dimensions about the keys to funds' survival, which include performance, risk management, fund size, age, style, characteristics and manager behavior. We will discuss these dimensions in section 3.

Secondly, we use the survival analysis to estimate the survival function, and to test whether or not these factors are good predictor variables related to hedge funds' survival. Lastly, we use simple indicators of survival to select funds and compare the performance and attrition rate with the Sharpe ratio. The paper will proceed as follows. Section 2 describes the data set and analyzes the behavior of leading funds in each style. Section 3 discusses the factors of survival. Section 4 introduces the methodology of the survival analysis and the empirical results. Section 5 introduces a simple application of fund selection and the conclusion in Section 6.

## 2. Data description and behavior of leading funds

### 2-1. Behavior of leading funds

According to the academic approach[5] and the volatility of the sub-style index[6], we can roughly divide strategies into two different styles, which include directional and non-directional strategies. The directional style includes Emerging markets, Global Macro, Long/Short Equity Hedge[7], Managed futures and Multi-strategies. Non-directional styles include Convertible arbitrage, Equity market neutral, Event-driven and Fixed income arbitrage. We observe the specialties of leading funds[8]

[5] Directional strategies generally employ the market timing approach, which bet on the direction of market and used one side trading (only long or short position) to capture gains of trend. Non directional strategies do not depend to direction of market and aim to exploit structural anomalies of markets and achieve low volatility. They usually construct simultaneously both long and short positions to decrease risk exposures of market. However, some styles such as event-driven and multi-strategy are hybrid of market timing and non-directional approach. They show the low to zero correlation with most market index but more volatile than non-directional approach. Fung and Hsieh (1999) points that global, global/marco, short/sellers, and long only belong to market timing style and market neutral equity belong to non-directional. As hybrid style, Ararwal and Naik (2000b, 2004) regard event-driven as non-directional category due to less volatile than market timing.

[6] If we could not directly judge the style group, then we use the volatility of fund of funds index from 1994 to 2004 as a threshold to assist judgment due to the FOFs representing the portfolio with diversification. If categorical fund on average is less volatile than FOF index, it tends to closely the goal of non-directional category.

[7] Although the Long/short equity seem to classify into non-directional group by literal meaning, it generally just take net long-only or few hedging short position in practice. So we still regard them as market timing category.

[8] We regard the leading funds as successful funds, which could manage so enormous assets and be still

in each style, which have at least a five year track records and the top five US dollar AUMs at the end of 2004.

**1. The majority of successful funds have the advantage of raising capital at the initial stage, and outperform than their style indices or come close to the industry average**

Table 2 reports the description of size, performance, risk and managers' skill of leading funds. Panel A shows that the quantiles of initial fund sizes for most leading funds are between 70% and 99%, and only a few funds are below 50%. This means that, related to the same-style competitors, the majority of successful funds have the advantage of raising capital at the initial stage. This initial strength of AUMs may come from the value of their reputation and provide enough revenue to cover basic operational costs. On the performance side, the annual returns of directional funds range between 8% and 44.02%, and relative returns from –5.5% to 33.46%. Most of them, with the exception of Global Macro, outperform than their style indices or are near to the industry average. So do the non-directional cases, whose performances are far smaller than the directional ones due to being relatively low risk. The approximately three quarters of leading funds have a positive and significant Jensen's alpha[9], which means that most managers for successful funds can earn positive alpha gains, and have better managerial skills than other same-style competitors, except for high-risk types, such as Global Macro, whose emerging market and managed futures are not obvious.

**2. Funds with an initial small size have to use different instruments to expand their scales and survive to match the concerns of investors**

Especially leading funds, with the smallest initial size of each category, perform best, and of course, if the initial small funds want to survive and succeed, they would certainly be outstanding among their competitors. In contrast to the measures of risk given in panel B, the positive relationship of the rewards/risk ratio hold, and all measures of risk for the initial smallest directional funds generally have higher values. For example, the fund with the fifth ranking of the Global Macro (i.e. the initial AUM quantile is 15%) is riskier than other leading funds. The standard deviation of the monthly return is 9.08%, which is at least twice that of the others, and the other

alive today; they should have more competitive strengths than others because of passing many severe tests by giving in the market and investors.

[9] We employed the market model to estimate the alpha, beta and used the TASS style index as a proxy for the industrial market portfolio. Generally

measures are all consistent. (i.e. beta, maximum monthly loss, maximum drawdown [10] and average drawdown are 0.41,-28.82%,-16.83%, and -8.67%, respectively.). These figures respond to the approach that small young funds for survival adopt high risky tactics to achieve an outstanding performance, and cumulate a reputation and scales quickly during the initial period. However, this phenomenon does not hold in non-directional cases. For example, the fund with the fifth ranking Event driven (i.e. the initial AUM quantile is 42%) is steadier than other leading funds in all measures of risk. The maximum monthly loss is 1.92%, which is half of the others. (i.e. beta, standard deviation, maximum drawdown and average drawdown are 0.41, 1.245%, -2.74%, and -1.51%, respectively.), and this reflects the different investment philosophy and focus of directional and non-directional funds. The latter stresses steady profits and keeps risk exposure to a minimum. The performance is too volatile to attract new flows and attention due to the risk of violating their safety requirements. Thus, small young funds of the non-directional type have to control their losses and keep stable rewards instead of chasing amazing returns if they want to expand their scales and survive in the long term.

**3. Opposing extremes of trading manners in the directional style having a survival space and a clear strategic position of risk is a necessary condition of successful funds**

The proportion of leading funds with significant and positive beta to all funds is 84% (i.e. 38/45=84%). Three-quarters of the leading funds whose beta coefficients are smaller than 1, are less volatile and risk relative to the overall same business. However, beta values in excess of one are concentrated on managed futures and fixed income arbitrage. If funds have good risk management and a good stop loss mechanism, the maximum loss reflects the quality of risk control and awareness of unexpected shocks. Hence, we observe that the statistic of monthly maximum loss is a proxy for a degree of risk control. Most of the first ranking funds have smaller measures of risk and prefer to offer steady profits. This represents the fact that investors would rather sacrifice some returns than take more risks.

[10] Drawdown is defined as the uninterrupted decline in net asset value from the highest historical point and as a percentage loss.

Relatively, leading funds incepted after 1998, which are more careful about risk control after learning lessons from financial disasters, and may have a better time point to build a new position after market crashes, have small maximum losses except Managed futures and Equity market neutrals. However, it is an interesting phenomenon that the aggressive and conservative leading funds exist in the same directional style, and the opposing extremes of trading manner have survival space to attract investors with different accepted degrees of risk. Of course, funds survive on the premise that they are able to provide good profits. For example, the first and the fifth ranking funds in long/short equity have different attitudes about the management of risk. The former provides quiet returns as well as a style index and maintains a low degree of losses, but the latter outperforms by 6.7% than the style index per annum and the maximum loss or drawdown is close to five times the former. The first ranking fund of emerging markets even has the attribute of high risk, which has always lost –63.79% in a single month, and other risk measures are 2 or 3 times than other leading funds, but it still manages 1.2 billion of assets now due to providing enough fascinating profits Hence, the clear strategic position of risk and return is a necessary condition of successful funds

**4. There is no evidence to support the fact that leading funds have a better defense for a down market than the same style competitors, but they have the capability of recovering maximum losses or drawdown**

We employed the market timing model proposed by Henriksson and Merton (1981)[11], which can be regarded as being a combination of the CAPM model and the protective put option of a market portfolio (i.e. strike price is risk free rate), to compare the capability of market protection as a downtrend than the average of the same industry. We will introduce the market timing model in the next section, and will now review the results of leading funds.

The $\alpha_2$ (ie.alpha2) reflects the risk-adjusted return after controlling market risk and market timing factors, and $\beta_2$ is the market-timing measure and positive value which

[11] Henriksson and Merton (1981) model can be regarded as the combination of CAPM model and protective put option on the market portfolio (i.e. strike price is risk free rate)

$$r_{i,t} - r_{f,t} = \alpha_{2,i} + \beta_{1,i}(r_{m,t} - r_{f,t}) + \beta_{2,i} Max(0, r_{f,t} - r_{m,t}) + \varepsilon_{i,t}$$

Where $r_{i,t}$ is the monthly return of i fund at time t; $r_{m,t}$ is the monthly return of style index at time t; $r_{f,t}$ is 90 days T-Bill rate. Compared with down market beta (i.e. Down market beta= $\beta_1$- $\beta_2$) and up market beta (i.e. $\beta_1$), the former is larger than latter, it means that it can't offer protective function as downside.

represents the fact that the fund has a market-timing ability and is less sensitive in the down market than in the up market. In other words, it implies that funds with positive $\beta_2$ have better market protection in a downtrend than the same style competitors. Panel C gives a description of managerial skills.

The proportion of leading funds with a significant and positive alpha2 to all is 44.4% (i.e. 20/45). This indicates that above half of the leading funds do not have better risk-adjusted excess returns than the same business after considering the effect of market timing. However, the leading funds with multi-strategies indeed have better managerial skills and selective ability than other similar businesses. On the market timing side, only 26.7% of leading funds have the significant ability of market timing and protective function than the average same style competitors. However, 17.8% of leading funds have the opposite results (i.e. significantly negative $\beta_2$), and there is no evidence to support the notion that leading funds have a better defense for the down market than the average same-style competitors. Relatively, leading funds which are Event driven have a more obvious protective effect for downtrend and market timing ability among all styles. As far as being capable of recovering losses, most leading funds recover their losses and the recovery time depends upon the degree of loss. A few funds could not recover from maximum losses since they occurred near the end of the sample period. Funds without the ability to recover maximum losses do not survive because investors stop loss and choose another better investment.

**5. Different initial sizes lead to different investment philosophies as young age. Successful funds with an initial small size will dynamically adjust their risk/reward relationship during the lifecycle phase**

We are interested to know about the behavior of leading funds at each phase of their lifecycle and their performance during financial shocks. Hence, we compared the time series pattern of two funds with the largest and smallest sizes at the beginning, which were incepted before 1998[12]. Figures 1 and 3 show the trend of 12-months' buy and hold returns and the volatility of each style from its inception to the end of the third year.

[12] Relatively, funds which are incepted after 1998, have small losses because they are more careful about risk control by learning lesson from financial disasters. Besides, new funds hurt lightly due to small position in 1998 and even take the opportunity of pessimistic market to set up their position. Thus, they can make profits as rebound after deeply drop. We hope to observe whole picture about leading funds then choose the observed funds incepted before 1998 that they have to go through the shock of LTCM and technology bubbles.

Overall the absolute performances of small funds in the first year were 15% (annual return) at least, and were better than the larger ones, except for CB arbitrage and the Equity market neutral case. However, the small fund of the CB case provided 44% return in the second year. In other words, funds without initial capital strength may take advantage of their small position and flexibility to implement a better trading strategy for attracting a high level of rewards. The performance of small funds is very important during the first two years of inception because they have to expand their size to cover operating costs as soon as possible.

Furthermore, we analyze the behavior of leading funds with initial small AUM[13] over the first three years of the establishment and calendar time series from 1997 to 2004. Figures 2 and 4 show the trend of 12-months buy and hold returns and the volatility of each style from January 1997 to November 2004. We can group leading funds into three types according to the pattern of returns and volatility.

1. The first type is an extreme adventurer such as Emerging market, Global macro and Managed futures

In the case of Emerging markets and Global Macros, it was incredible that the annual returns of successful funds exceeded 100% and the scale also rapidly increased more than 15 times in the first year[14]. They achieved at least a basic threshold of survival at the end of the first year. After the first year their performances were unable to be maintained as well as before and changed radically. From figures 1 and 2, we can clearly observe that their gains or losses were always several times the style index and contrastive fund (i.e. initial large size) in any lifecycle phase. In addition, figures 3 and 4 show that the volatility was kept at a high level and was more volatile than the equity and industrial market, whether they were young in age or not. Basically, they belong to extreme adventures of risk and do not provide a protective function in a slump. However, they possess an excellent ability of recovering losses. They do not only recover the maximum losses but also make more profit as the market rebounds. Generally, they have better trading skills than the same-style competitors, which could

[13] Because most of the sample funds have small capitals at initial period, we observe the behaviors of leading funds with small size on their behalf.

[14] For example: the 12 month buy and hold return of the Emerging market and Global macro leading funds were 298% and 158%, separately. And the AUMs of the first year grew up from 5 million to 77 million for Emerging market case and from 655 thousand dollars to 21million for Global macro case.

be verified from their significantly positive Jensen's alpha. In contrast to these, funds with initial large AUMs provided a near payoff to the industrial market and had a flatter pattern of volatility than the style index after the year 2000.

In relation to managed futures, their initial sizes may be minor, because they invest futures or option contracts, which need only small margins to achieve the purpose of holding large positions and creating high profits. Thus, the patterns of the performance or volatility of both leading funds were similar and predominated their style index in any lifecycle phase.

2. The second type is an adventurer during the young age and then funds revise their risk attitude as they reach more large scales, such as L/S equity and CB arbitrage

These funds create high profits, high volatility and expand their AUM to the survival threshold within the first three years[15]. Indeed, an obvious discrepancy can be seen between the initial large fund and the small one during the young age. The leading fund with the initial large AUM kept the flat or L shape trend of payoff and volatility, such as the L/S equity case and the CB arbitrage case, which may underperform or keep the same as the style index after the first year. They stressed safe and stable returns, although it is very important that reputable funds keep good records and continue to manage them forever. Therefore, small funds start to change their trading behavior when their scales have grown to the degree of their lasting operation. In other words, their behavior becomes more and more like that of initial large funds, which care about protection in a downturn and have a less volatile performance. It is verified by figures 2 and 4, this that initial small funds of L/S equity and CB arbitrage cases have performed good protection as in a bear equity market and their volatility patterns are similar to their initial large ones after the year 2000.

3. The last type is a seeker of stable rewards, such as multi-strategy, Event driven, Equity market neutral and fixed income arbitrage.

Most non-directional funds belong to this type and match their attributes of risk. For the

[15] For example: the 12-months buy and hold return of Long/short equity was 66% and AUM grew up from 1.3 million to 22 million in the first year. The cumulative return and AUM were 120% and 51million at the end of the third year. For CB arbitrage case, the cumulative return and AUM were 74% and 34 million at the end of the third year.

multi-strategy case, figure 1 demonstrates that both funds with initial different sizes have almost a flat and consistent pattern of returns and volatility, providing at least 15% annual return in the first three year. However, both of them pay less attention to relative performance, which is inferior to same-style competitors. It is meaningful that, to avoid following losses after a hot market by means of delaying gains to maintain smoother rewards, we see a good defense against a slump during a bubble burst from figure 3. Nevertheless, the performance of initial small funds is superior to that of large ones, but more volatile.

The cases of Market neutral and Event driven are consistent with the multi-strategy, although the trend of volatility slightly decreased over time and the peaks of return and volatility all occurred within the first year. More especially, a small fund of equity market neutral is more conservative and has a lower performance than a large one when young, which implies that the device of expanding the AUM to achieve the threshold for equity market neutral fund offers safe and persistent rewards instead of amazing returns[16] in single month. Previous evidence can be introduced as follows. Firstly, the absolute performance of young funds is really important, although small funds based upon the pressure of expanding scales and building reputations tend to take more trading risks to attract a better performance than large funds. As for the concerned degree of relative performance, this depends upon the attributes of each strategy.

Secondly, funds with the initial advantage of capital tend to regard stable rewards as their first goal, while the small funds start to change their behavior to be consistent with the former as long as they have reached the safe threshold of size. Afterwards, the behavior of both resembles each other and focuses upon risk control. Thirdly, adventurers of risk aggressively chase high rewards as their first goal, although they have no resistance against unanticipated shocks. Although they are unable to provide a protective function during a market slump, they have a good ability of recovering severe losses once the market stabilizes. In other words, excellent trading skills and recovering ability are necessary conditions for adventurers. Fourthly, there is still a great difference in the trading behavior of successful funds, even in the same style of strategy, and

[16] For example: the 12-months buy and hold return of Equity market neutral was 14.75% and AUM grew up from 3.6 million to 39 million in the first year. The cumulative return and AUM were 53.5% and 359 million at the end of the third year

therefore, the difficulty of finding common and consistent behavior of hedge funds by using pool data is raised. It may be expected that some anticipated evidence may be offset and lack of statistical support.

### 2-2 Data description and the select principles of the successful group

In terms of observing the behavior of the successful group to detect the key factors of survival, we need to define the selective principles of this group. However, in the analysis of some issues such as characteristics still used the whole of the sample funds instead of group data in consideration of sample size. According to previous ideas, long track records, more consistent attributes of investment style, and an excess of the survival threshold of size are required conditions by intuition. The selective principles and reasons are as follows.

**Long track record**

A long enough track record can ensure experience of the wind-out test of industry and unexpected market shocks, such as financial crises, and the technology bubble. In addition, funds with a long track record are not only representative, but can also reflect more complete dynamic behavior during different lifecycle periods. By means of the previous study of industrial development, we know that the mean of the survival duration of defunct funds is less than four years, which can be regarded as the time limit of being forced to exit because of poor performance. So we need successful funds to have had at least a five years track record, and to still be alive at the end of 2004. In other words, the funds were incepted before the year 2000.

**More consistent attributes of investment style**

It has been seen that the patterns of risk/reward, investors' requirements and manager's behavior are distinct for each style, according to previous evidence of leading funds and industrial development. Moreover, the different trading styles should be separated for observation because investors have different a focus of requirement, according to their risk attributes. If the analytic samples are grouped by the type of strategic style and other required conditions, we will face the problem that the results are incredible, and not representative, because the analytical numbers of the funds will be too small. So we still only divide two groups of strategic styles, namely directional and non-directional strategies, and the reasons for this classification are given in the previous introduction.

**Achieving survival threshold of size**

Achieving the survival threshold of size can assure funds of keeping stable revenues to cover the fixed costs of operation and provide the stakes to develop know-how and human resources[17]. So we believe that a basic scale of funds exists to maintain the essential operation under general conditions. When the funds encounter large losses due to unexpected great shocks, funds with large scales have a relatively better capability of withstanding losses and provide a greater buffer to wait for the market to rebound than small size funds. In other words, the probability of instant liquidation or insolvency is low for large funds compared to small ones. So we believe that a safe threshold of scale exists for withstanding the pressure of redemption and providing a buffer period to recover losses. Hence, we set the basic and safe threshold of scales by means of the quantiles of the last assets for live and defunct funds.

Table 3 displays the percentiles of the last AUMs for the live funds and the defunct funds, and it can be seen that differences do indeed exist in the scales of the final AUM between directional and non-directional funds, whether live or defunct. For example, the medians of the directional and non-directional live funds are $45million, $82 million respectively. The non-directional funds usually construct both long and short positions to earn structural spreads and decrease market exposure, and therefore, they need more capital to hold two side positions than directional funds. We know from industrial development that most defunct funds belong to small scales, except for no reporting funds, and that the observed time investors are willing to give to those funds without profits gradually decreases over time. Thus, young funds should hasten to expand their scales to reach the basic threshold for survival. Table 3 exhibits that the 75$^{th}$ percentile of the final assets of defunct funds incepted before the year 2000 (i.e. total:$ 24.3 million, directional:$ 19.3 million, non-directional : $ 56.3 million) is close to the 25$^{th}$ percentile of live funds (i.e. total:$ 20.8. million, directional:$ 18.5 million, non-directional : $ 41.9 million ). So we used the 75$^{th}$ percentile of defunct funds as the basic threshold of survival, which means that the probability of fund survival and the final AUMs without exceeding the threshold is 0.25, but if funds become defunct, it is

[17] When the AUM of a fund is too small to create enough revenues, the fund could not survive due to uncovering the cost of operation and lack of excellent human capital. If the fund could not provide the good incentives to attract talents, it is unable to develop know-how of trading and continuous operation.

0.75. Moreover, based on the same idea, we set the 90th percentile to be the safe threshold. According to the above principle to set the threshold, the basic and safe thresholds for directional and non-directional funds are $19.5million, $59.807 million, $53.162million and $146.52million respectively. Based upon the two thresholds, we can divide three groups of all funds. If the final AUMs of the funds exceed the safe threshold, the funds belong to group 1. If the final AUMs of the funds do not reach the basic threshold, the funds belong to group 3, unless the final scales are between the safe and basic thresholds, in which case the funds can be classified as group 2. Based upon the above principles, the major analytic sample of live funds incepted before the year 2000 is group 1. This represents the successful group, whose dynamic behaviors we are interested in observing, for their lifecycle and differences with other contrast groups during the same period.

Our sample[18] consists of 1531 individual funds incepted before the year 2000, which include 654 live funds and 877 defunct funds. Details of the sample size of each group are given in Table 4, Panel A. When we regard group 1 of the live funds as being the successful group, there may be doubt as to whether this group is a good representative of common funds. If most funds in group 1 have the congenital advantage of initial capital, the behavior and risk taking tactics will be different from those of new funds without any strength. This consideration agrees with the previous detection of the behavior of leading funds. Thus, we need to check whether or not evidence exists about the differential level of the initial scales between group 1 and other contrasting groups. Hence, we consider both the initial and final AUM level. The fund is classified as group 0_1 if the initial AUM exceeds the basic threshold, otherwise to group 0_2. Table 4 Panels B, C and D report the proportion of the number of funds with initial large or small AUMs to all numbers of funds in each group and the mean[19] of the initial and last AUM in each group.

In the directional case, the proportion of funds with high initial capital to all funds in groups 1 and 2 are roughly 27%, 19% and indeed higher than group 3 (i.e. 7%), although 70% of the funds which still belong to group 0_2 need to expand their AUM to reach the basic threshold during the young age. Moreover, the advantages of initial

[18] As to the groups of funds incepted after year 2000, we still use these data to analyze characteristics of funds for comparison with analytical groups. The sample include 987 individual funds, which contain 778 live funds and 209 defunct funds

[19] The results of mean are consistent with the median.

capital do not result in the difference of the final scales in contrast to the level of the initial and last AUMs in group 0_2. For example, the mean of the initial AUM of groups 1, 2 and 3 are $ 5.97million, $4.29 million, and $3.97million respectively. However, the capital of group 1 is twice the size of that of other groups. Compared with their last AUMs, the means of the last sizes are $ 388.4million, $34.533 million, and $8.26million, and the gaps have increased 5-25 times. Basically, the non-directional case has a consistent result, so the funds of group 1 still have a certain degree of representation for funds.

## 3. Discussion on the factors of survival

### 3-1 Fund specific characteristics

We know from research that some specific characteristics of hedge funds have a significant relationship with the survival rate. Thus, we can check whether or not these characteristics have changed over time and compare the live group and the defunct group. Tables 5 and 6 report the proportion and the mean level of funds with each characteristic among fund groups, and the results of testing them are shown in Table 7.

(1). High water mark

Managers of hedge funds generally charge a management fee plus a percentage of the fund's profits, called an incentive fee. Due to the asymmetric compensation frame, managers can still earn high bonuses in a good performance year, even is losses were great in the previous year. Thus, the high water mark provision requires manager to first make up past losses by compensating gains before allocating incentives, to ensure the interests of investors. The proportion of all funds with the high water mark for live and defunct groups is given in table 5, and this is 75.3%, 30.1% respectively. From table 7 Panel A, it can be seen that the ratio of live groups is significantly higher than that of defunct groups. The high water mark provision is indeed an important factor of hedge funds' survival. Nevertheless, the proportion of funds with the high water mark is evidently increasing over time, whether in terms of the live or defunct groups from table 6, Panels B and C. The ratio of all directional funds has shifted from 34.4% to 86.6% and that of non-directional funds has moved from 35.3% to 92.9%. This means that the

protection of investors' interests has become more valued as the industry has developed. Most new funds have this provision so that there is less difference between live and defunct groups than before. Hence, it is anticipated that there will be fewer and fewer hedge funds without this characteristic.

(2) Leverage

Tables 5 and 6 report that the proportion of funds with leverage to all live and defunct groups are 67.2%, 75% respectively and, in addition, the mean levels of the average leverage for both are 0.9 and 0.51. Basically, using leverage to enhance the performance of hedge funds is very common, but the level of using leverage should be considered. The means of average leverage for directional and non-directional styles are 0.5 and 1.26 times. The ratio of funds with leverage to the defunct group is significantly higher than the live group, whether directional or non-directional. Nevertheless, table 7, panel A demonstrates that the level of average leverage for non-directional defunct funds is significantly lower than that of the live group (i.e.Live vs. defunct: 1.65 vs. 0.65) and there is no significant difference in the directional case. (Live vs. defunct 0.54 vs. 0.46). It is surprising that live funds trade aggressively by means of high leverage to achieve a better performance instead of defunct funds in the non-directional case. Nevertheless, table 6 Panel B shows that the levels of average leverage do not change over time, whether in the live or defunct groups. Relatively, the level of average leverage seems not to be a major factor of directional funds' survival, but it is important for the non-directional type.

(3). Personal capital

The characteristic of personal capital means that managers invest their own money in their funds. It seems logical that managers would more seriously operate the fund if they put their own money into it, and yet the proportion of funds with personal capital for all live and defunct groups is only 35.5%, 49% respectively. However, there is a statistical difference between live and defunct groups, whether directional or non-directional. (i.e. directional case: Live vs. defunct: 38% vs. 48%; in non-directional case: Live vs. defunct 29% vs. 51%). This result does not match our expectation. Instead, more defunct funds have this characteristic. This may suggest that the reputation cost and

other pressures persuade managers who manage the capital of their clients to operate funds gingerly. In addition, the above half of the funds without this provision still survive, and the proportion of having personal capital is significantly decreasing over time. The ratio of directional funds shifted from 52% to 27% and that of the non-directional funds moved from 49% to 12%. Relatively, this characteristic of funds is becoming more unimportant over time due to a great deal of capital from institutional investors entering the industry. Thus, it is not a key to funds' survival.

(4). Lockup period and Redemption period

The provision of a lock period means a window of time during the initial period of inception, in which investors are not allowed to redeem. This provision gives managers a more flexible space to trade and asset allocation, such as illiquid investments and lower amounts of cash, to achieve good performance during their young age. The proportion of funds with a lockup period provision to all live and defunct groups are 37.1%, 16.5%, and in addition, the mean levels of lockup period for both are 4.29 and 1.86 months. Table 7 Panel A reports that the ratio and mean levels of live groups are all significantly higher than those of the defunct group, although the effect of this characteristic for affecting survival is limited, due to the above 60% live funds not having this provision.

Compared with table 7 Panels B and C, the proportion is evidently increasing over time, whether of the live or defunct groups. The ratios of all directional funds have shifted from 17.9% to 43.3% and the non-directional cases have moved from 21.2% to 42%, which means that more managers are recently tending to use the provision of the lockup period to protect the initial set-up position and to exempt them from the problem of cash outflow during their young age. It is indeed a good tool for managers to stabilize trading and decrease the disturbance of outflows in the competitive and increasingly systematic risk environment. Another provision of liquidity after the initial lockup period is the frequency of redemption, which also helps managers to avoid the liquidity problems in the short run. Table 7 exhibits that the mean levels of the redemption period for directional and non-directional style are 2.28 and 2.85 months and that the latter have a significantly lower liquidity frequency than that of directional funds.

(5). Audit

The characteristic of audit means that fund managers have provided recently audited

physical financial statements to TASS. Liang (2000) demonstrates that audited funds tend to have better data quality and exhibit more reliable and accurate returns than those without an audit. Generally, external auditors finish the audited financial reports after passing a more unbiased examination and evaluation process. This provides objectivity of financial information, and this characteristic reflects the quality of the manager's attitude of disclosure of financial information. The proportion of all audited funds of live and defunct groups are 74.2%, 55.2%, and indeed, live fund groups are more willing to reveal better information than defunct groups. Although the proportion is evidently decreasing over time, this characteristic is still a good indicator for fund selection.

(6). Management fee and incentive fee

The mean levels of management fees and incentive fees for live groups and defunct groups are 1.38%, 19.46%, 1.39% and 18.85% respectively. Relatively speaking, live funds have more confidence to adopt a high pricing strategy for an incentive fee than defunct groups, but the difference between both is below 1%. The level of fee seems to be rigid and is not lowered over time with increasing competition. The overall fee structure is similar between live and defunct groups and this has no obvious influence on funds' survival.

### 3-2 Threshold of size, favorable position and Flow

#### 3-2.1 Threshold of size

**Speed of achieving a threshold between a successful group and others**

According to the previous description of a successful group (i.e. Group 1), we firstly observed the speed of achieving the basic and safe threshold for each initial small fund groups. Figures 5 and 6 show the trend of the proportion of AUMs below the basic threshold for groups of directional and non-directional styles from inception to 60 months. If the pattern declines sharply over time, it represents that the speed of achieving the survival threshold for that group is fast. Whether directional or non-directional style, the trend of each group almost decreases fast over time except for group 3, which reduces slowly, and then stays flat for two years after set-up. For example, 62% of directional live funds in group 1 exceeded the basic threshold within two years of inception, and only 12% of funds could not reach it by the end of the fifth year. In contrast with group 3 of live funds, 81% of funds did not achieve the threshold by the end of the fifth year. Table 8 reports the mean and median time the funds achieved the basic and safe threshold in each group. It can be seen that the time of achieving the threshold of the directional funds is approximately two or three years on average, although half of them achieved the target within 2 years, especially the capable funds in group 3 fast extended their size within 2 years (i.e. mean and median time of live group 3 is 23 and 18 months, defunct group 3 is 19 and 13 months) and the remainder cross over the threshold in later years. Hence, this implies that capable directional funds could attract attention and reach the basic threshold within 2-3 years. Relatively, funds have kept small scales for above three to four years from inception, and the probability of closure is increasing. Thus, it may be that the screen indicator for funds selection is whether or not AUMs achieve the threshold within 2 years.

**Survival rate of different initial size groups**

We are interested in understanding if the advantage of initially raising capital affects the survival of funds, and in addition, if funds which are capable of expanding their scale within two years can survive longer than those which do not reach the threshold. Firstly, we induced some defunct funds into live funds but excluded liquidated funds. Defunct

[24] The adjusted principle is that funds could survive as long as managers are willing to keep fund operating. At least the lack of size and recently poor performance do not result in immediately closure.

funds have similar attributes to live funds and need to satisfy two conditions[24]. One of which is having positive buy and hold returns prior to the last 6 and 12 months, and the other is that their last AUMs exceed the basic threshold, and then the survival rate of the initial small and large AUM groups can be calculated.

The adjusted proportion of the survival definition is the ratio of the adjusted live funds, which have been active for at least T months or are closed before T months, but have satisfied the conditions of size and performance to all sample funds. Table 9 Panel A illustrates the survival rate proportion of initial large and small funds. For example, the survival rates of initial large and small funds in the directional style at the end of the fifth year were 0.777, 0.567, and those of the non-directional style were 0.667 and 0.674. It can be seen that the gap of the surviving proportion of the directional funds with a different initial size keeps increasing, and then holds steadily over time, but that those of non-directional cases decrease after four years. The marginal effect of size of non-directional funds affects the survival rate during the first three years, and directional funds are more sensitive to size than non-directional funds. This result implies that the strength of the initial size has a higher influence of the survival rate of directional funds than that of non-directional funds. Perhaps this phenomenon can be interpreted as being that the attribution of directional funds tends to be more volatile. Hence, large initial scales can provide a better stake for bearing loss and trading flexibly.

Table 9 Panel B demonstrates the conditional probability of surviving T months of initial small funds, given that whether or not funds reach the threshold within 2 years of inception. The conditional probabilities of surviving one year of directional and non-directional small funds, given to reach the threshold within two years, are 0.945, 0.9588 respectively. In contrast with not exceeding the threshold, the probabilities are 0.807 and 0.884. It can be seen that the survival proportion of the group with the exceeding threshold is higher than that of the non exceeding threshold group, and the gap of both stabilizes over time. According to prior results, we know that capable funds expand their size to the basic threshold within 2-3 years, and that these small funds begin to change their behavior to be consistent with initial large funds as long as they reach the threshold of size. It can be observed from Table 9 Panels A and B that the decreasing degree of the survival proportion per year of initial large funds is close to the

conditional survival proportion of those exceeding the threshold within 2 years. Thus, we further compare the performance of funds with an initial large size and those of funds which exceed the basic threshold within two years and show the results in Panel C, from which it can be seen that the performance of the latter is more stable and better than the former after the third year. If we want to invest medium funds, the funds which exceed the basic threshold within two years may be a better choice than funds with an initial large size.

### 3-2.2 Favorable position and flow

According to the evidence of developments in the hedge fund industry, the survival conditions are stricter than before due to competition and a change of investors' requirements. Hence, the change of flow would be a good measure to respond to industrial competition and investors' requirements. Getmansky (2005) found that the flow and favorite degree of investors, which indirectly affects the subsequent category competition due to the increasing numbers of new entrances, were negative in relation to funds liquidation. We are interested to know whether or not the closure of funds is related to the worst of the flow and the degree of favoritism by investors. If the issue holds, it means that the flow rate and the favorable position of defunct funds begin to worsen during the last periods and a difference exists between the closed time of the defunct funds and the normal operating period of live funds, which still survive at the end of the observational time. We take the favorable positioning metric[25] (FAV) proposed by Getmansky (2005) to measure the favorites of investors. The quarter flow[26] and FAV are defined as follows:

$$DollarFlow_{i,t} = AUM_{i,t} - AUM_{i,t-1}(1+r_{i,t}) \quad (3.2\text{-}1)$$

where $AUM_{i,t}$ is the monthly assets under management of i fund at time t
$r_{i,t}$ is the monthly return at time t

$$QuarterDollarFlow_{i,t} = \sum_{j=0}^{2} DollarFlow_{i,t-j} \quad (3.2\text{-}2)$$

where Quarterly dollar $flow_{i,t}$[27] is calculated by aggregation of dollar flow $_{i,t}$ over a quarter.

[25] The FAV measures the proportion of a fund category increase in net dollar flows compared to other categories.
[26] Quarter flow is quarter dollar flow scaled by the beginning of quarter AUM.
[27] Semiannual dollar flows are calculated by aggregation of monthly dollar flow over a semiannual.

$$QuarterFlow_{i,t} = QuarterDollarFlow_{i,t} / AUM_{i,t-3} \quad (3.2\text{-}3)$$

If category k has net positive flows during the quarter, the FAV formula as follows

$$FAV_{k,t} = \frac{\sum_{i,i\in k} QuarterDollarFlow_{i,t}}{\sum_{i,i\in POSNET} QuarterDollarFlow_{i,t}} \quad (3.2\text{-}4)$$

where POSNET is a set of category flows which are net positive during the quarter

If category k has net negative flows during the quarter,

$$FAV_{k,t} = -\frac{\sum_{i,i\in k} QuarterDollarFlow_{i,t}}{\sum_{i,i\in NEGNET} QuarterDollarFlow_{i,t}} \quad (3.2\text{-}5)$$

where NEGNET is set of category flows that are net negative during the quarter.

$$-1 \le FAV_{k,t} \le 1$$

Table 10 exhibits the mean level of the flow and FAV for each defunct fund group over all durations and the last 3, 6 and 12 months before exit[28]. It can be seen that the flows and FAV of directional defunct funds during the last 3, 6, 12 months are less than their mean values over all duration. Besides, the FAV of large defunct funds over the last 3 and 6 months are -9%, -7% and the other groups still remain positive. The flows of all defunct groups over the last 3 and 6 months are negative, and only the last 12 months retain inflows except for the small funds group (i.e. Group 3). This evidence illustrates that the flow and favorable position of directional defunct funds has worsened roughly during the last semiannual. Relative to medium and small funds, the favorable degree change of investors is more harmful to the survival of large funds. The result of the non-directional funds is similar to that of the directional funds, but the effect of favorable degree is not obvious.

In order to confirm that the flow rate and favorable position could affect funds survival, we need to test the difference of the worst degree of those between defunct funds and live funds over the last 3 and 6 months. The defunct group represents the condition of fund closure at the time of observation, and the live group reflects the condition of funds retaining normal operation, which includes some defunct funds which were active at the

[28] Table 10 and 11 show the results for the sample of fund incepted before year 2000 and the sample of all funds have the consistent result.

time of observation. If the difference in the worst degree between the defunct and the live groups is significantly negative, this means that the flow and favorable position had indeed worsened to affect the funds' survival. Firstly, we calculated the difference between the quarterly flow and the average value at time t for each individual fund as equation (3.2-6)

$$Dif(flow)_{i,t} = flow_{i,t} - \frac{1}{t}\sum_{n=1}^{t} flow_{i,n} \quad Dif(FAV)_{i,t} = FVA_{i,t} - \frac{1}{t}\sum_{n=1}^{t} FAV_{i,n} \tag{3.2-6}$$

where $Dif(flow)_{i,t}$ is the difference between the flow and mean of i live fund at time t

$Dif(FAV)_{i,t}$ is the difference between the FAV and mean of i live fund at time t

Then we calculated the cross-sectional mean of the Dif $(flow)_{i,t}$ and Dif $(FAV)_{i,t}$ by group. The cross-sectional mean of live funds which still survive at time t is calculated as equation (3.2-7) and that of the defunct funds being closed at time t is calculated as equation (3.2-8).

$$DIF(Flow)_{live,t} = \frac{1}{N_{survive}} \sum_{i \in survive} Dif(flow)_{i,t} \quad DIF(FAV)_{live,t} = \frac{1}{N_{survive}} \sum_{i \in survive} Dif(FAV)_{i,t} \tag{3.2-7}$$

Where $DIF(Flow)_{live,t}$ is the mean of $Dif(flow)_{i,t}$ for $N_{survive}$ live funds at time t;

$DIF(FAV)_{live,t}$ is the mean of $Dif(FAV)_{i,t}$ for $N_{survive}$ live funds at time t;

Survive is set of active funds at time t.

$$DIF(Flow)_{defunct,t} = \frac{1}{N_{close}} \sum_{j \in close} Dif(flow)_{j,t} \qquad DIF(FAV)_{defunct,t} = \frac{1}{N_{close}} \sum_{j \in close} Dif(FAV)_{j,t} \tag{3.2-8}$$

where $DIF(Flow)_{defunct,t}$ is the mean of $Dif(flow)_{i,t}$ for $N_{close}$ defunct funds at time t

$DIF(FAV)_{defunct,t}$ is the mean of $Dif(FAV)_{i,t}$ for $N_{close}$ defunct funds at time t ;

Close is set of defunct funds being closed at time t.

Then we test the difference between both of the time series of cross-sectional means to ensure that the defunct funds do indeed have the fastest worst degree of the flow and FAV. The results of the difference between the defunct funds and the live funds are shown in Table 11. The means of DIF (FAV semiannual) for all directional defunct funds and live funds are -0.06 and -0.03; the DIF (flow semiannual) are -0.46 and -0.54,

where it can be seen that there are no significant differences to support that fact that the flow and favorable position of the directional defunct funds has become worse over the last semiannual.

However, if we further observe the test results of the groups, we can find some useful information. A significant difference exists in the favorable position in the large funds group over last 3 and 6 months, and the same significant difference existed in the small and medium funds group over last 6 months. This evidence implies that the recent change in favorable position by investors results in the attrition of large funds, which have achieved a safe threshold, and the disadvantage of flows also affects the survival of small funds without exceeding the basic threshold. In addition, the worst degree of flows during normal operation is significantly better than the closed time for the medium funds group (i.e. group 2). This implies that, once the sizes have reached the basic threshold of survival, the marginal importance of flows of directional funds decrease relatively due to having great stakes to manage the change of flows.

In the non-directional case, there are significant differences to support the fact that the flow rate of all defunct funds became worse over the last 3 and 6 months and so did the favorable position over the last quarter. The mean of DIF (FAV_quarter) for all defunct funds and live funds are -0.06 and -0.01, the DIF (flow_quarter) are -0.26 and 0.55. The results for this group are similar to those of the directional funds. Overall, the stability of the flows is the key to survival for small funds without reaching threshold, and change of favorite by investors is one factor which leads large funds to close. Therefore, the change of favorite position also illustrates why some funds have decided to change their investment strategy in recent years. Some large funds of convertible arbitrage strategy have especially changed their style to multi-strategy.

### 3-3 Performance and risk

Table 12 provides the summary statistics of the returns for each group from January 1994 to November 2004. Panel A reports the statistics of the monthly return for each group and the testing results about the mean difference of performance and risk between mutual groups are given in appendix table A1. Panel B shows the distribution of the autocorrelation for each group and various measures of performance and risk are shown in Panel C.

***1. Provide a good performance and keep a good track record as in the past***

In terms of directional funds, the absolute and relative performance of a successful group (i.e. Live group 1, mean of average monthly return 1.426%, annualize 17.1%; mean of average active return[30] 0.507%, annualize 6.1%) indeed predominates other live groups (i. e. relatively medium and small funds). However, there is no significant difference between the average performances of the defunct group 1(i.e. defunct group 1, mean of average return 1.512%, annualize 18.1%; mean of average active return 0.488%, annualize 5.9%). Basically, the average performances of the defunct group are close to the same scale of live groups, except defunct group 3, which has a significantly poorer performance than the other groups and the same-style competitors, (i.e. Defunct group 3, mean of average monthly return 0.51%, annualize 6.12%; mean of average active return -0.425%, annualize -5.1%). As expected, on average, one reason for the closure of directional defunct funds without exceeding the basic threshold is an inferior performance compared to most competitors. However, the other defunct funds which do exceed the threshold have a better performance than small live funds, and we need to check whether or not the closure is related more to the worst performance than their historical records. This especially values the strenuous building reputation of large scale funds which may choose to close, or stop reporting, in consideration of retaining good historical records when their performance begin to worsen or the uncertainty of the market is on the increase. If the issue holds, it means that the performance of defunct funds worsens during the last periods and a larger decline of performance exists than that of live funds.

[30] The active return is defined as the difference between the return of the fund and the return of style benchmark index. It also calls the relative return.

The performance of defunct funds over the last 3, 6 and 12 months before exit are given in Table 13 Panel A, where it can be seen that the performance has fallen behind with the same-style competitors since the last 12 months before exit. The means of average active return of each group are all negative. For example, the values of group 1 over the last 3, 6 and 12 months were -4.63%, -5.09% and -1.97% respectively. Generally, the medium and small-scale groups provide negative rewards and their losses are enlarged close to ending time. For instance, the absolute average returns of group 2 over the last 3, 6 and 12 months were -7.50%, -4.46% and -3.24%, respectively. In contrast with large defunct funds, they still provide positive rewards during the last year. However, panel B shows that the returns become worse relative to their historical performances, and the average returns of group 1 during the last 12 months and all surviving months were 2.52% and 18.14%. Compared with the historical performance, the mean and median of differences were -15.62% and -8.91%, and in addition, 79% of them were inferior to the past performance. Besides, the proportions of providing negative returns and active returns over the last 12 months and below the past average performance were 38% and 58% respectively. This implies that large funds were closed because profits appeared as a downtrend or dropped behind with same-style competitors, even though they were still providing positive rewards to investors. We believe that the reputation and good track record of managers of large funds are relatively important because these are the best advertisements for raising new funds in the future.

In order to confirm the greatest worst performance than historical records for defunct funds over last m periods, we needed to test of the worst degree between defunct funds and live funds. At first, we calculated the difference for each individual fund between the m-periods moving average return and average value over all of the duration at time t.

$$Dif(r)_{i,t} = \frac{1}{m}\sum_{j=0}^{m-1} r_{i,t-j} - \frac{1}{t}\sum_{n=1}^{t} r_{i,n} \qquad (3.3\text{-}1)$$

where r is the monthly return, $Dif(r)_{i,t}$ is the difference of the i live fund between m-periods moving average returns and average over all duration at time t.

Then we calculated the cross-sectional mean of the difference for live funds group, which still survived at time t, and defunct funds being closed at time t. We test the

difference between both the time series of cross-sectional means to ensure that defunct funds indeed had the fast worst degree during the last m period, and the result is exhibited in Table 14[31]. The differences between moving average returns and mean returns are negative for all funds due to decreasing returns to scales, and as expected, defunct funds have significantly greater worst degrees than live funds, whether absolute or relative performance. This has begun to show signs of a lessening performance before the last 12 months. Relatively, the performance of funds which exceed the basic threshold (i.e. Group 2) has declined quite substantially and the worst degree has expanded over time. For example, the difference between the monthly returns of the last 12 and 6 months is -1.17% (i.e. annualize -14.06%) and -1.55% (i.e. annualize -18.58%) respectively. However, large size funds at least controlled the worst degree of performance, but there was a lack of improved signs over the last 6 months. Thus managers may choose closure or may stop reporting so as to retain good historical records while waiting for an opportunity for a comeback in the future. This evidence implies that funds with scales may be closed if they cannot keep profits as they were in the past, or maintain the same level of performance as other competitors. The overall results of non-directional funds are consistent with the directional case, although both cases have two differences. Firstly, unlike the directional case, the successful funds do not have a relatively remarkable performance, especially since the defunct funds which reached the threshold performed as well as they did on average. Secondly, the group of large defunct funds is the same as other defunct groups which had a significantly great worst degree of performance during the last year, and losses got out of control close to the ending time.

The major reason why large funds chose to leave based upon keeping records or considering the market conditions, is that they showed signs of performance decline during the later period. As for the small funds which did not reach the basic threshold (i.e. group 3), these were eliminated since they lacked performance and competitive power.

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[31] The difference will be relatively small if the calculation of average value includes the observations of moving average sample, hence, we also repeat the same procedure for using the average value and excluding observations of moving average sample t. The testing result can refer to appendix table A2. The difference of i live funds between m-periods moving average returns and average over all duration at time t is as follows: $Dif(r)_{i,t} = \frac{1}{m}\sum_{j=0}^{m-1} r_{i,t-j} - \frac{1}{t-m}\sum_{n=1}^{t-m} r_{i,n}$

***2. Better risk-adjusted performance and relatively more risk awareness***

Panel C shows three measures of risk-adjusted return, namely Sharpe's ratio[32], information ratio[33] and Jensen's alpha[34]. It can be seen that all risk-adjusted performances of small defunct funds are apparently inferior to other groups and the results are consistent with the previous analysis. Besides, half of the successful funds provide significantly positive Jensen's alpha, and the mean values are better than other groups (i.e. significant ratio of directional case: 52.59%, mean of Jensen's alpha: 0.754%, annualize 9.48%; significant ratio of non-directional case: 67.74%, mean of Jensen's alpha: 0.386%, annualize 4.63%). This implies that the managers of successful funds have a better ability of managerial skill than other same-style businesses.

Table 12 Panel A and appendix table A1 illustrate that, regardless of the absolute and relative volatility, successful groups (i.e. Live group 1 of the directional type, mean of standard deviation of monthly return 4.848%, mean of standard deviation of monthly active return 4.633%; Live group 1 of the non-directional type, mean of standard deviation of monthly return 1.81%, mean of standard deviation of monthly active return 1.78%;) are indeed significantly smaller than the others groups. In addition, small defunct groups (i.e. Defunct group 3) have the largest volatility of all. Besides, we observed other measures of risk, such as the market beta with respect to the fund's style benchmark, the maximum of monthly loss and the maximum loss with respect to the style benchmark[35], the maximum and average drawdown, which is defined as the uninterrupted decline in net asset value from the highest historical point, and as a percentage loss, in Table 12 Panel C. We care about the degree of loss because this reflects the quality of risk control and exerts pressure on managers which affects their

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[32] Sharpe ratio is calculated as the difference between the average monthly return and risk free return, which used average 90 month T-Bill rate, divided by the standard deviation of the return.

[33] Information ratio is calculated as the active return divided by track error, where active return is the difference between the return of the fund and the return of TASS style index and tracking error is the standard deviation of the excess return.

[34] We used the market model to calculate Jensen's alpha and the market model is as follows:

$$r_{j,t} - r_{f,t} = \alpha_{1,j} + \beta_j (r_{m,t} - r_{f,t}) + \varepsilon_{j,t}$$

where $r_{i,t}$ is the monthly return of j fund at time t; $r_{m,t}$ is the monthly return of TASS style index at time t; $r_{f,t}$ is 90 days T-Bill rate.

[35] Because observed funds have experienced the systemic shock at least, the maximum of monthly loss may be relation in unstable market condition, therefore, we deduct the corresponding benchmark to recalculate the loss as called excess maximal loss.

behavior. Basically, each measure of risk is negative in relation to the terminal scale in the directional case. However, there is no statistic significance between same-scale live and defunct groups.

Of course, successful funds in the directional type seem to have more risk awareness, but the live funds without threshold take more risky measures than the small defunct group. Whether mean or median, the values of live group 3 are the highest among all groups (i.e. average market beta is 0.803, average maximum of monthly loss and respect to excess maximum loss are –18%, -7.41%, and average maximum drawdown and average drawdown are -20.32%, -8.8%) and next are defunct group 3. This evidence implies that small funds which exceed five years from their inception, which take high risks to enhance performance, cannot expand their size rapidly due to lack of risk control and awareness. Basically, they are similar to the defunct group 3 and become the next potential closures. In terms of these small funds, survival or closure is possibly decided by their ability to recover when facing large losses. In order to survive, small funds may have no choice but to adopt risky trading to improve their performance when facing large losses. If they take the risk and gamble, they will survive as long as the gambling succeeds. On the contrary, if they do gamble and lose, they close. Hence, small funds, whether in live or defunct groups, have a high value for each risk measure.

In non-directional cases, as expected, the groups of defunct funds obviously have a higher risk than live groups. Because their investment philosophy is offering safe and steady rewards instead of amazing returns, their investors generally have a high aversion to risk. Therefore, funds will probably dry up once the losses get out of control or the performance becomes volatile.

***3. It is important for non-directional funds to defend against tail risk***

The previous figures show that the successful funds seem to provide more attractive returns and lower volatility than other live and defunct funds. However, care must be taken to observe their hidden tail risk because there is only a hint of separation between the survival and failure of these same scale funds. It can be seen that non-directional funds actually have a larger kurtosis and a more negative skewness than the directional funds in Table 12 panel A. In addition, the defunct funds which have reached the threshold have the largest kurtosis and negative skewness. (i.e. defunct group 1, mean of

skewness -1.122%, mean of kurtosis 9.7). Whether they are live groups or defunct groups, the larger the scales, the higher the tail risks of funds. The stable and better performances offered by them may be regarded as premiums by means of short volatility, and therefore, the good ability of management against tail risk for non-directional funds is the key to survival.

In contrast to directional funds, the shocks of tail risk are relatively small, due to their more volatile attributes. Successful funds have a positive skewness, a lower volatility and fatter tails than small and medium funds. However, it can be seen that more extreme losses and gains appeared as a result of rapidly expanding their scale at the young age and later decreasing the returns to scale. Successful managers still make enough gains to decrease the shock of extreme losses (ie. positive skewness).

***4. Concern for the stability of performance***

The existence of serial correlation among the hedge fund industry is very common, especially in groups of successful funds and the non-directional type. Besides, the ratios of live funds are high and decrease slowly compared to the group of defunct funds. Table 12 Panel B exhibits that the proportion of the existing serial correlation between the first 12 orders of the successful groups of directional and non-directional type are 41% and 67%, respectively. Lo (2004) proposes that the serial correlation can reflect illiquidity risk exposure, and that especially non-directional funds are easy to smooth returns by means of investing illiquidating instruments. Hence, it may be interpreted that, in order to match investors' demands, fund managers paid more attention to stability and persistence of performance per period once successful funds had expanded their sizes to an objective level. The strength of positions and capital can help large funds to smooth their returns. It is common behavior to transfer unrealized profits to the next quarter (or year) if the budget has achieved this quarter (year) in practice. Other evidence, given in Figure 7, is that the stability of performance is more important than the value, and this is illustrated in the following section.

***5 Adjustment of priority of risk and performance along with lifecycle change***

According to the previous statistics of the initial AUM, we know that most small sized funds are of a young age. Therefore, we are interested to know how they behave at a young age and whether or not their behavior changes throughout their lifecycle. We

focus on the behavior of successful funds with an initial small size over time (i.e. G1_small), and other groups of initial small live funds (i.e. G2_small, G3_small) and successful funds with an initial large size (i.e. G1_large)[36] are the control groups.

Figure 7 illustrates the patterns of the performance and volatility of each group over the first three years from inception. No matter whether absolute or relative performance decreased progressively over time, the rewards of all groups in the directional type almost achieved a high peak during the first one to two years from inception. In addition, funds which created a notable track record in the beginning have relatively more chance of survival in the future. It can be seen that all measures of performance for successful funds (i.e. G1_small) dominated other live funds and decreased slowly over time, besides which the peak of volatility also occurred in the first year. The values of G1_small gradually converged and then came close to G1_large after the first two years, and this implies that the new objective of successful funds was greater stability of performance after they had aggressively expanded their scale to reach the specific goal and entered a mature period.

Basically, the managerial directions of successful funds with initial small size in this phase are the same as funds with a large initial size, which have a flatter trend of volatility than other live groups, and only offer better returns than average same-style competitors. The behavior of both is more similar and consistent. The steady growth of AUMs and the control of risk become the next managerial priority. In contrast to the defunct group, their performance is quite uncompetitive at a young age. However, the funds want to survive as long as they provide a good performance over average same-style competitors, even having a large risk such as G3_small, which has the largest volatility among all groups in Panel B. However, if they want to attract investors' attention to expand their scale, they have to reduce the volatility and maintain the same profit level.

The evaluation of young funds is different between the non-directional and directional,

[36] The successful funds are divided into two groups, namely "G1_large" and "G1_small". The G1large funds means that their initial AUMs have exceeded the basic threshold and that the last AUMs still stay over the safe threshold. As the same principle, G1_small funds means that the initial AUMs do not exceed the basic threshold.

since the stability of the rewards is the most important thing for non-directional funds. Whether their initial size is large or not, successful funds generate near the horizontal trend of volatility and retain a very low level. Young funds which use volatile trading to earn a better performance cannot achieve the purpose of expanding scales. An obvious example is the G3_small group, which offered high absolute or relative returns in the first two years, after which their performance rapidly decreased. Investors are so sensitive to losses and risks that they would rather choose funds with low and stable returns than those with attractive and volatile returns. Of course, small funds still have to outperform over average same-style competitors during a young age if they are not to be eliminated, although investors can accept the relative performance inferior to average funds only if the scales are large enough. Therefore, it can be seen that the observations of active returns or information ratio for G1_large funds are negative during the first three years.

***6. Better alertness and response to market shocks***

It is quite a common phenomenon that the equity market is full of hot money and takes an over optimistic view of the future outlook before the market crashes. Therefore, managers will not aim to chase the outperformance of other competitors during an extremely optimistic market, but will reduce risk exposure by means of stopping gains early if they are vigilant against bubbles. Thus, we expect that the relative performance of successful funds underperform compared to the same-style rivals prior to the occurrence of a shock, and outperform after a crash. Therefore, we need to check whether they are more alert about financial shocks in advance and are only lightly harmed. We observed the trend of absolute and relative returns of successful funds for around 12 months when great financial shocks took place, and we chose four events to observe, which are given in Figure 8. These include the Asian crisis (1997/7), LTCM collapse (1998/8), the technology bubble peak, (2000/3) and the 911 attack. (2001/9) There is evidence to show that non-directional funds generally kept a low correlation with the equity market and had attributes of steady returns and low volatility. The influence of the market shocks was relatively small except for the LTCM collapse, which was more relevant to non-directional funds and made them take large losses, but successful funds suffered less damage than average same-style competitors and resumed the level of normal-profit within three months after the shock.

There is no obvious pattern to support the fact that successful funds were more alert to market shocks in advance, but they certainly had a better response to them. In the directional case, successful funds provided positive returns most of the time and showed less losses after the shock. They displayed a protective value as the market dropped rapidly. In terms of the relative performance, the result in the first case, the Asian crisis, did not match our expectation, with the performances of successful funds being superior to the same business during the last half-year before the crisis and having no obvious dominance after the crisis. However, the learning effect of the awareness of risk gradually emerged in later events such as the Dot Com bubble, where underperformance was exhibited during the last half-year before the bubble peaked (i.e. t from –1 to –6) and there was an obvious outperformance during the year after the peak. (i.e. t from +1 to +12). Successful funds performed better than their average rivals and tended to stop gaining early, from the first-half year before the bubble (i.e. t from –12 to –7). This indicates that successful funds have a better awareness of risk than their same business rivals. The 911 attack, which occurred in the bear market during the modification of bubbles, had a different attribute to prior crises and only had a temporary influence on the market. The successful funds traded more aggressively to make profits during the pessimistic and low volatility age, and therefore, they had a better performance than their same-style competitors, whether the shock occurred or not. In general, successful funds of the directional style had learned their lesson from the financial crisis and exhibited a better vigilance of risk and protection as the market dropped sharply.

### 3-4 Management skill in performance and risk management

#### 3-4.1 Selection skill, Market timing capability, and downside protection

We applied the market-timing model of Henriksson and Merton (1981), which uses the Options Theory to explain market timing ability, and checks whether the managers of successful funds have a better market timing ability than those of other groups. In addition, we know that good risk-adjust returns come from a market timing ability or security selection ability by means of a market timing analysis. According to the evidence of the development of the hedge fund industry, most hedge funds keep a low correlation wit the US equity market, and their R square values of the market model are low except for long/short equity. We used the portfolio of the CS/Tremont style index as a proxy of the market portfolio instead of the S&P 500 index, and the reason for this is that hedge funds are able to survive relatively if they can catch a possible shift in the direction of the industrial market or have a better alertness of the down market in advance of same-category competitors.

The Henriksson and Merton (1981) model can be regarded as being the combination of the CAPM model and the protective put option on the market portfolio (i.e. strike price is risk free rate) and is expressed below:

$$r_{i,t} - r_{f,t} = \alpha_{2,i} + \beta_{1,i}(r_{m,t} - r_{f,t}) + \beta_{2,i} Max(0, r_{f,t} - r_{m,t}) + \varepsilon_{i,t} \quad (3.4\text{-}1)$$

Where $r_{i,t}$ is the monthly return of i fund at time t; $r_{m,t}$ is the monthly return of the CS/Tremont style index at time t; $r_{f,t}$ is 90 days T-Bill rate.

If funds managers have a better ability of market timing, they should correctly forecast the market direction and adjust the fund's market exposure. Hence, the market timing should have different beta in the up and down markets. If $r_{m,t} \geqq r_{f,t}$ the equation (3.4-1) becomes equation (3.4-2) as follows, the$\beta_1$ present up-market beta.

$$r_{i,t} - r_{f,t} = \alpha_{2,i} + \beta_{1,i}(r_{m,t} - r_{f,t}) + \varepsilon_{i,t} \quad (3.4\text{-}2)$$

If $r_{m,t} < r_{f,t}$ the equation (3.4-1) become equation (3.4-3) as follows , the ($\beta_1$-$\beta_2$ ) present the down-market beta.

$$\begin{aligned} r_{i,t} - r_{f,t} &= \alpha_{2,i} + \beta_{1,i}(r_{m,t} - r_{f,t}) - \beta_{2,i}(r_{m,t} - r_{f,t}) + \varepsilon_{i,t} \\ &= \alpha_{2,i} + (\beta_{1,i} - \beta_{2,i})(r_{m,t} - r_{f,t}) + \varepsilon_{i,t} \end{aligned} \quad (3.4\text{-}3)$$

The $\beta_2$ measures the market timing ability of fund managers, and if $\beta_2$ is a significantly positive value, this means that fund managers have superior market timing ability. In addition, a positive value of $\beta_2$ represents the fact that the market exposure of funds is less sensitive in the down market than the up market[37], which can be viewed as a protective effect.

The $\alpha_2$ reflects the performance after controlling the market timing. In contrast with the market model, Jensen's alpha reflects the risk-adjusted return after controlling the market risk. We can use a market-timing analysis to prove whether a good risk-adjust return comes from a market timing ability or a security selection ability. If fund managers generate a good risk-adjusted return (i.e. positive and significant Jensen alpha), we can further judge the sources which come from a security selection (i.e. positive and significant $\alpha_2$ ) or market timing (i.e. positive and significant $\beta_2$). In addition, the positive value of $\beta_2$ also ensures that the market exposure of funds is less sensitive in the down market than the up market (i.e. Down market $\beta = \beta_1 - \beta_2 <$ up market $\beta = \beta_1$) and the fund provides a protective put effect.

Table 15 exhibits the mean and median of performance and risk parameter estimations of hedge funds by the market-timing model during 1994 to 2004. In addition, table 15 reports the proportion of positive and negative selectivity performance measures ($\alpha_2$) and market-timing ( $\beta_2$) measures and results of tests between mutual groups are given in appendix table A1.

No matter whether directional funds or non-directional funds, the mean level of the selectivity performance index of successful groups significantly predominates that of other live groups, although there is no significant difference with the same-scale defunct group 1. (i.e. the significant positive ratio of the directional case: 38.79%, the mean of annualized $\alpha_2$ : 8.17%; the significant positive ratio of non-directional cases: 44.09%, the mean of annualized $\alpha_2$ : 4.2%). Nevertheless, only two-fifths of successful directional funds have significant positive $\alpha_2$ and roughly 40.52% of successful directional funds have positive $\alpha_2$, $\alpha_1$ (i.e. Jensen's alpha) and former is larger than the latter. In terms of these funds, their managers have more superior selection abilities and managerial skills than those of their same category rivals. Except for the defunct group

[37] Down market $\beta = \beta_1 - \beta_2 <$ up market $\beta = \beta_1$ if $\beta_2 > 0$

3, the mean or median of $\alpha_2$ coefficient for other groups are positive and the ranges of significant ratios are roughly from 20% to 30%. Although the significant ratio of $\alpha_2$ for the successful group is higher than other control groups, the gap between them is not apparent, and more than half of the funds do not have a better selective ability than the same businesses. There is a lack of sufficient evidence to say that the managers of successful funds have better selection skills than those in the same category.

As for market timing and downside protection, the mean and median level of $\beta_2$ of the directional successful group is 0.077, 0.06, respectively. The ratio of significantly positive and negative $\beta_2$ is 22.41%, 15.52%. Only 1/4 of the successful funds can catch the possible shift in the industrial market direction and have a better alertness of the down market in advance of same-category competitors. Their returns are less affected in down markets than in up markets. Basically, the proportion of successful funds is close to those of the control group. However, there is not sufficient evidence to support the fact that successful funds have a better defense for down market and market timing ability than the average same-style competitors. The result of the non-directional case is also consistent with that of the directional case.

### 3-4.2 Stop loss and recovery ability of the maximum loss

Lo (2002) and Barton Biggs (2006) emphasize the importance that hedge funds stop loss at an opportune moment, and we believe that the maximum loss may be regarded as a proxy for the upper limit of loss. If the fund has a well-developed mechanism of risk management, the maximum loss reflects the result that the fund establishes the upper limit of acceptable losses in consideration of various risk resources. However, it is more important that the fund has the ability to recover its prior loss and stabilize investors' confidence after stopping the losses. According to the previous results of leading funds and small live groups, we know that the extreme adventurers of risk, or small live funds, have no resistance against downside risk but they have a good ability to recover severe losses once the market stabilizes. The recovering ability of maximum loss is a necessary condition of survival for adventurers. Hence, we further investigate the difference between the recovering ability after the occurrence of maximum losses of successful groups and other control groups. In order to measure the recovery degree and ability of maximum losses, we construct two dynamic indicators for them.

**Measure of recovery ability (recovery rate)**

$R_{maxloss,i}$ represents the loss of the monotone increasing time series for the i fund at a particular time period T

$t_{maxloss,i}$ represents the order time series when the i fund suffers a larger loss than before

$$R_{Maxloss,i} = \{r_{i,t(1)} r_{i,t(2)} \ldots\ldots r_{i,t(n)}\}$$

$$t_{Maxloss\ ,i} = \{t(1), t(2), \ldots\ldots t(n)\}$$

where $0 < t_{(1)} < t_{(2)} < \ldots\ldots < t_{(n)} < T$; $r_{i,t(n)} < \ldots\ldots < r_{i,t(2)} < r_{i,t(1)} < 0$

$r_{i,t(n)}$ represents the maximum loss of the i fund during the whole sample period which occurs at time t(n)

$NAV_{maxloss,i}$ represents the time series of the month-beginning value of net assets when the fund suffers the maximum loss

$$NAV_{Maxloss,i} = \{NAV_{i,t(1)-1} NAV_{i,t(2)-1} \ldots\ldots NAV_{i,t(n)-1}\}$$

$$RC_{i,t} = \frac{\sum_{k=1}^{t} d_{i,k}}{t} \qquad (3.4\text{-}4)$$

where $t \in [t_{(j)} t_{(j+1)})$

if $NAV_{i,t} \geq NAV_{i,t(j)-1}$ $d_{i,t} = 1$

$NAV_{i,t} < NAV_{i,t(j)-1}$ $d_{i,t} = 0$

$d_{i,t} = 1$ represents the fact that the net asset value of the i fund has recovered to its prior level before suffering the maximum loss at time t.

Hence, the $RC_{i,t}$ represents the proportion of the recovering counts of the maximum loss in terms of all of the observations of the i fund, from its inception to time t. If the recovery rate is high, it means that the possibility of recovery from the maximum loss is high according to the past behavior of the fund. We also repeat the same procedure to calculate the recovery rate of the i fund which corresponds to a CS/Tremont style benchmark at time t. (i.e. $Mkt\_RC_{i,t}$). This measure can help us to understand the frequency of the industrial market's recovery from loss during the same observational period. The difference between the recovery rate of a corresponding market measure of the i fund and the i fund as equation (3.4-5) can help us to understand whether or not the fund has a better recovery ability than same-style businesses under the same observation. We regard $RC_{i,t}$ and $dif\_RC_{i,t}$ as the absolute and relative measures of recovery ability.

$$dif\_RC_{i,t} = RC_{i,t} - Mkt\_RC_{i,t} \quad (3.4\text{-}5)$$

**Measure of the recovery degree**

The funds have to make a continual profit after the occurrence of maximum losses, so that it can reduce the threat of withdrawal of money and closure. However, the time periods of observation for following the recovery are 3, 6, 9 and 12 months because most investors are not willing to observe for too long a period. In addition, the defunct funds are divided into two groups, namely "defunct 1" and "defunct 2. The "defunct 1" means that defunct funds were actively working for at least one year before the maximum loss occurred. The "defunct 2" means that defunct funds were closed within one year. In order to understand the following recovery, we construct the measure of the recovery degree as equation (3.4-6)

$$Rd_{i,m} = \frac{NAV_{i,t(n)+m} - NAV_{i,t(n)}}{NAV_{i,t(n)-1} - NAV_{i,t(n)}} \quad (3.4\text{-}6)$$

where t(n) represents the time point that the i fund incurred the maximum loss during the whole sample period; $NAV_{i,t(n)}$ the month-beginning value of net assets of the i fund at time t(n) m= 3, 6, 9 and 12 (observed period)

If the ratio is higher, this means that the degree of recovery is better. $Rd_{i,m} > 1$ means that the i fund did not only completely recover its maximum loss, but also made additional profits, and allowed its NAV to reach a high level after m months when the maximum loss occurred. The $Rd_{i,m} < 0$ means that the i fund did not only un-recover its maximum losses but also continually expanded them. $0 < Rd_{i,m} < 1$ means that the i fund recovered part of its loss after m months. For example, $Rd_{i,3} = 0.8$ represents the fact that the i fund made profits in three month after incurring the maximum loss and the total gains can compensate for 80% of the loss.

Table 16 shows the statistics of recovering from losses of each group from January 1994 to November 2004. The mean of recovery rate in the directional successful funds is 0.75, and 59.9% of them has a better recovery ability than same-style businesses, in addition, the mean level is significantly higher than other control groups. The ratio of recovering maximum loss for the directional successful group is 90%, that for the other live groups is 70% at least and the defunct groups roughly range from 35% to 45%. According to prior statistics of the maximum loss or drawdown, the degree of loss for the successful group is lower than the other different-scale groups, however, there is no statistic

significance between the same-scale live and defunct groups. Nevertheless, the recovery ratios of them are significantly different. The recovery ratios of maximum drawdown are the consistent with those of the maximum loss. The recovery ability of maximum loss during the tolerant period given by investors becomes a necessary condition of survival.

Furthermore, it can be seen that the mean and median time of the successful group recovery from their maximum losses is 10.4 months and 6 months. In contrast with the successful group, the time of the same-scale defunct group is 5.2 months on average. (i.e. median time is 3.5 months). However, the recovery speed of the defunct group is faster than the live group; those funds without the recovery are closure after nine months on average. (Median time is 6 months). The other control groups also have the similar results, thus the six months maybe is a good estimation of the tolerant period of investors. When the funds suffer from the great losses, the managers have to make a continual profit to compensate the partial loss during the tolerant time; otherwise investors may stop losses and choose another better investments. So we further observe the recovery degree of each group after the occurrence of maximum losses.

Table 17 demonstrates the degree of recovering from losses and the proportion of no recovery from losses after 3, 6, 9 and 12 months when the maximum losses occurred. The ratios of the successful group that do not only un-recover its maximum losses but also continually expand loss after 3, 6, 9 and 12 months are 29%, 22%, 17% and 17%, respectively. The other ratios of the live or defunct 1 groups are roughly near to 30%. It indicates that 70% of them have controlled the degree of losses and begin to make gains to cover partial losses after 3 months. However, half of the defunct funds that are closed within one year (i.e. defunct 2) has continually expanded losses. Whether the live or defunct 1 group, the degree of recovering from loss is increasing over time. For example, the half of the successful funds recovers from the 86% loss after six months and is complete recovery after nine months. In contrary to the defunct 2 group, half of them recovers 10%-20% loss or expands loss after 9 months. So the difficulty of survival for the funds lack of recovery ability is very high especially in the competitive environment. As concerns a few successful funds without complete recovery within one year, they have already recovered its maximum loss at the end of 2004, but the defunct funds do not. The reason that these funds are not ended within one year may causes of their reputation that let investors be willing to give them longer tolerance period.

As for the non-directional funds, most result is consistent with the directional funds, but there exists some differences. The recovery time and the tolerant period of investors for non-directional funds are shorter than those of the directional funds. Of course, the recovery time depends upon the degree of losses; hence, the recovery speed of the non-directional funds is faster than the directional funds due to the low degree of losses. When the large funds face the maximum loss, the threat of closure for them is higher than small funds. The large funds without the recovery are ended after four months on average when the maximum loss occurred. (i.e. median time is one month). In addition, the degree of loss for defunct 2 is larger than the other groups; the funds still are closed within one year even they can recover from the maximum loss. The table 17 reports half of large defunct funds completely recovers loss and makes additional gains 3.98 times size of the loss after 9 months. It sufficiently reflects their specialty of the sensitivity of the losses and aversion to risk.

## 4. Methodology of survival analysis and empirical result

### 4-1 Methodology

In this part we use 2518 individual funds, which include 1475 live funds[38] and 1043 defunct funds, covering the period January 1994 to November 2004. We will employ the Kaplan-Meier estimator and Cox proportional hazard model to investigate the survival time and testing for the effects of covariates, which used the key factors from the section 3. The survival function S(t) is defined as the probability that the fund survives at least until time t. Let survival time T be a positive random variable with distribution function F(t) and density f(t), the survival function is defined as

$$S(t) = \Pr(T > t) = 1 - F(t) \qquad (4.1\text{-}1)$$

The p.d.f is defined as

$$f(t) = \frac{dF(t)}{dt} = -\frac{dS(t)}{t} \qquad (4.1\text{-}2)$$

The hazard function is defined as

$$\lambda(t) = \lim_{\Delta t \to 0} \frac{\Pr(t \le T < t + \Delta t \mid T \ge t)}{\Delta t} = \frac{f(t)}{S(t)} = -\frac{d}{dt} \log S(t) \qquad (4.1\text{-}3)$$

**Nonparametric method-The Kaplan-Meier estimator**

The Kaplan-Meier (KM) estimator is the common nonparametric method for estimating survival functions.

Suppose there are m distinct failure time, $t_1 < t_2 < \ldots\ldots < t_m$.

$n_j$ is the number of funds alive immediately preceding the jth failure

$d_j$ is the number of funds who failure at time $t_j$

$(1-d_j/n_j)$[39] represents the conditional probability of survival at interval end to be the jth failure, given that fund is alive at the beginning of interval

The KM estimator is defined as[40]

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[38] We induce 43 defunct funds excluding the liquidation, which contain 32 directional funds and 11 non-directional funds, have similar attributes as live funds. They have the positive buy and hold returns prior to the last 3,6 and 12 months and the last AUMs exceeding $20 million for the directional funds and $50 million for the non-directional funds.

[39] $1 - \frac{d_j}{n_j} = \Pr(T > t_j \mid T > t_{j-1})$

[40] The equation is achieved through multiplying all conditional probability

$$\hat{S}(t) = \prod_{j:t_j \le t} (1 - \frac{d_j}{n_j}) \qquad (4.1\text{-}4)$$

for $t_1 \le t \le t_m$. $\hat{S}(0) = 1$

We employ the Kaplan-Meier model to estimate the survival function of all fund and then use the log-rank Chi-square to test for effect of fixed covariates[41]. The test can help us to find out the individual impact of each covariate on survival, and also to know the simultaneous impact of their combination on the survival time. The testing result is useful for screening covariates before proceeding to estimate Cox regression model. According to prior discussion and literature, we simply illustrate the five categories of covariates that affect the funds survival.

1. Characteristics:
   (1). Binary variables: Audit, High water mark (HWK), Leverage, Own capitals provision. If the fund has the provision, the binary variable is one.
   (2). Fixed covariates: Fee, Incentive fee express as a percentage. Minimum investment express in $ thousand. Lockup time (Lock_t) and Redemption time (Rem_t) express as months.
2. Size: average monthly AUM express in $million.
3. Performance/risk: average monthly return and standard deviation, average monthly active return and standard deviation.
4. Recovery ability:
   (1). Binary variables: The d_recover is one if the fund has recovered from the maximum loss at the end
   (2). Absolute and relative recovery rate (RC, dif_rc): The RC represents the proportion of recovering counts of maximum loss to all observations during whole lifetime. The dif_RC is the difference of recovery rate between the funds and their corresponding market. The definition refers to equation (3.4-4) and (3.4-5). The RC and dif_RC regard as the absolute and relative recovery rate.
5. Flow and competition: quarter flow and industrial favorable positioning at the end of exit. The definition refers to (3.2-3) and (3.2-5)

According as the findings of section 3, we expect that Audit, HWK, Lock_t, Rem_t, size, performance measures, d_recover, RC, dif_rc, flow and FAV have the positive relationship with the survival time. Only the risk measures are negative. As for the

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$S(t) = \Pr(T > t_j) = \Pr(T > t_{j-1}) * \Pr(T > t_j \mid T > t_{j-1}) = \Pr(T > t_{j-1}) * (1 - \frac{d_j}{n_j})$

[41] The method treats the covariates as a set, and can test the null hypothesis that they are jointly unrelated to survival time or test for certain incremental effects of adding variables to the set.

performance fee, manage fee and minimum investment from the literature; the relations with survival time are not consistent. Based upon the rigidity of the pricing strategy, the fee and incentive fee may not affect the fund survival.

**Semi-parametric method- Cox proportional hazard model (Cox PH model)**

Cox PH model is widely used in the analysis of survival data to explain the effect of predictor variables (i.e. covariates) on hazard rate; it allows an unspecified form for the underlying survivor function. We employ the Cox PH model with time-dependent covariates and the model is written as:

$$\lambda(t;\beta,z(t)) = \lambda_0(t)\exp(z(t)^T\beta) \qquad (4.1\text{-}5)$$

Where $z(t)^T$ is the transpose of the time-varying covariate vector z at time t

$\lambda_0(t)$ is an arbitrary base-line hazard rate

β is the vector of coefficient and use the partial likelihood function to estimate the coefficient

The Cox model produces a hazard ratio (HR) for each covariate. The hazard ratio represents the percent change of the hazard rate when the value of the covariate changes one unit. It means that the covariate decreases (increases) the hazard rate when HR is smaller (larger) than one. We use both of the fixed and time-dependent covariates in the Cox PH model. Basically, the characteristics of hedge funds rarely change over time; hence, they are treated as fixed. From the prior discussion, we know that many funds are terminated due to the quality of operation worsening recently. The quality of operation generally displays in the performance, fund size, risk and recovery from losses aspects and changes over time. Therefore, it is reasonable to treat these covariates as time varying variables and their definitions are as follows:

1. Size ( AUMs(t) ): average monthly AUM during previous 12 months and express in $ million.
2. Performance and risk:
   (1). Ret_year(t): 12 months buy and hold return
   (2). Under_year(t): a binary variable that is one if the 12 months buy and hold return is negative.
   (3). Alpha_year(t)[42]: the ratio of active return over 12 months to the annual standard deviation of active return, it also represents the risk-adjusted return and calls information ratio.
   (4). Ex_std_ret(t): the standard deviation of active returns over 12 months

[42] According to Brown, Goetzmann, and Park(2001) model, we used the under_year and Alpha_year to measure the absolute and relative performance.

(5). Std (t): the standard deviation of returns over 12 months

3. Recovery ability, Flow and competition: the definitions are introduced in the preceding illustration but these covariates vary over time.

As for the relation between the hazard rate and these covariates should be opposite to those of survival rate as previous illustration.

**4-2 Empirical Result**

Table 18 reports the survival estimates and mean survival time of hedge funds by Kaplan-Meier model. From Panel A, we first observe the estimated probability that the hedge fund will survive for 60 months or more. The probability of the directional fund is 0.679, while the large funds and small fund are 0.873, 0.492, respectively. The probability of the non-directional fund is 0.749, while the large funds and small fund is 0.896, 0.592. According to the log-rank tests for style and size, there exist significant difference of survival function between the large and small funds. The chance that the large funds survive is far greater than that of the small funds. Of course, the surviving possibility of non-directional funds that emphasize the safety first is longer than risky directional funds. The difference of survival function between the directional and non-directional funds has statistic significance at 1% level. Panel B shows that mean survival time of all directional hedge funds is 82 months (i.e. 6.9 years), while those of the large and small funds is 95 months (7.9 years), 60 months (5 years) respectively. The large funds indeed outlive small funds. The finding is consistent with Gregoriou (2002) and Rough (2005).

Table 19 Panel A shows the univariate Chi-squares for the log rank test. The direction of relationship between these covariates and survival time is consistent with our expectation and prior discussion. It is special that the positive sign of the minimum investment indicates that funds with higher threshold of purchasing tend to have longer time to survival, but this result is opposite to Gregoriou (2002). The forward stepwise sequence of Chi-squares for the log rank test is given Panel B, where it can be seen that the effects of d_recover, RC and audit are the most explanatory contribution. Although the performance is key to survival, the better recovery capability from losses and quality of disclosure about financial information also increase funds survival time.

Table 20 exhibits the hazard ratios from the Cox PH model with time dependent covariates from 1994 to 2004. We can observe the effect of some predictor variables is different between the directional and non-directional group. In the characteristics of the audit, High water mark (HWK), leverage and Fee all significantly affect the hazard rates of the funds whether in directional group, non-directional group, or combination. We find the effects of the audit and HWK decrease significantly the risk of the hedge funds

closure. For example, the estimated hazard ratio of the variable HWK is 0.512, it represents that the hazard of closure for those who have HWK provision is only about 51% of the hazard for those who do not have HWK (controlling for other covariates). The result is consistent with Park (2007) but is contrary to Rough (2005)[43]. The audit also decreases the risk, the hazard for those who are willing to provide the audited financial report is only about 37% of those who do not provide. It implies that the funds which do not pay attention investor's right and have the potential agency conflicts will be eliminated from competition. So these characteristics of the audit and HWK will be a good indicator for fund selection. The HR of leverage is 1.46, in other words, the hazard of funds with leverage is 1.46 time of those without leverage.

For the quantitative covariates, we can subtract 1 from the HR and multiplying 100. This value means that the estimated percent change in the hazard for each one-unit increase in the covariate. For the lock time variable, the HR is 0.956, which the percent change is 100*(0.956-1) = -4.4. For each one-month increase in lock time, the hazard of non-directional fund is reduced by an estimated 4.4%. However, the lock time is no effect on the hazard of directional funds. It reflects that the non-directional funds trade some illliquidity investments to keep stable performances; hence, reducing the uncertainty of cash flows can help them to survive. Moreover, the directions that the management fee and incentive fee affect the hazard rate are opposite. Increasing management fee and decreasing incentive fee can reduce the risk of hazard; maybe it reflects the problem of agency conflicts with asymmetric compensation.

The results in the size, flow and industrial favorable positioning are consistent with prior discussion. Most directional funds tend to small scales; therefore, they are more sensitive to the cash flows than the non-directional funds. Hence, we find each one percent increase in Quarter flow, the hazard of directional fund is reduced by an estimated 32.4%. In contrast to the non-directional funds, the change of the flow dose not affect the hazard, but the change of industrial favorable positioning (FAV) influence it instead. For each one percent raise in the FAV, the hazard of the non-directional fund is reduced by an estimated 42.9%. The favorite degree by investors for the non-directional funds, which stress steady profits and keeps risk exposure to minimize, decreases the risk of hazard. When the great deal of cash outflows due to the change of industrial favoritism by investors, which may be withdrawn from this category to invest newly launched funds or major-style targets, increase the difficulty of survival for the non-directional funds because of requiring high threshold of size to operating.

[43] Rough(2005) finds that the High water mark increase the risk of liquidation. He explains that the funds with HWK provision are difficult to achieve the requirements once the losses incurred. The study does not find the effect of leverage and redemption time on survival.

The poor absolute performance over the last year of life and high volatility increase the risk of failure. Especially, the non-directional funds is evident, which the risk of failure for the funds with losses is 2.454 time of those without losses. The high risk-adjusted returns over the last year of life decrease the risk of failure, however, no effect of the standard deviation of active return. The result is consistent with BGP (2001) and Rough (2005) except for the volatility of active return. In recovery measures, the HR of d_recover is 0.648, in other words, the hazard of funds that have recovered from the maximum losses is 64.8% of those without recovering, however, the directional and non-directional funds have the similar results. For each one percent increase in recovery rate (RC), the hazard of directional fund is reduced by an estimated 51.6%, but the relative rate (Dif_RC) increases the hazard by 46.2% instead. In contrast with the directional funds, each one percent increase the relative recovery rate (Dif_RC) decreases the hazard of the non-directional funds by 62.7% and no effect of RC on hazard. The non-directional funds are so sensitive to the losses that the mangers tend to smooth returns and avoid losses, so the Dif_RC among most of funds generally are not too large. However, the relative recovery rate reflects the gap of recovery ability between the fund and average same-style competitors. The invertors of the non-directional funds would pay attention to the recovery condition of industrial market once the loss occurred. So the relative recovery rate for the non-directional funds is more sensitive to fund survival than RC. However, we believe the recovery ability of funds is still the valuable information about funds selection.

## 5. Application to fund selection

The main purpose of survival analysis in hedge funds is that assisting investors to avoid choosing funds which have encountered large losses to be liquidated or closed and select the funds that provide consistent returns and maintain good operation for a long time. According to the result of survival analysis, we have comprehended the factors of survival, but it is more important how to use these relevant information to select potential targets before due diligence. We have tried to use the in-sample data to estimate the survival function of each individual fund by the Cox model, and select investing targets by means of the high forecasted probability, which the funds will survive at least two years. However, the criterion is difficult to work in practice because the differences of survival probability in short term, such as one or two years, between the normal operating funds and good funds are very small. Nevertheless, we still use these information of fund survival to do simple application of fund selection.

We make use of the relevant covariates of survival function to select funds and form the portfolio at the end of each calendar year from 1996 to 2002. We use the four criteria of selection, which include one-year Sharpe ratio, one-year relatively risk-adjusted returns (i.e. Alpha_year), recovery rate (i.e. RC), and a composite score of survival. According to each criterion we select the top 24 ranking funds of the sample, which the new funds with less one year track record are excluded at that calendar year, then compute the attrition rate, equal-weighted and value-weighted monthly return of the portfolio in next one and two years. We hope the RC or the composite score can pick those funds that have the longevity or provide better performance than the Sharpe ratio. In addition, we repeat the same procedure to select the large and small hedge funds separately. If the AUM of the fund at the end of calendar year is above (below) basic threshold[44], then the fund is grouped into the pool of the large (small) funds.

Next, we illustrate the procedure of constructing the composite filter. Firstly, we use the most significant binary covariates of hazard to screen some potential funds with high risk of failure. However, in consideration of the less numbers of the funds pool , we only exclude the funds lack of providing audit reports, no high water mark provision, no

[44] The basic threshold of the directional funds and non-directional funds are US $ 20 million and US $ 50 million

recovery from the maximum loss and negative 12 months buy and hold return from the pool. In the second step, we separately rank all active funds in the pool according as each significant time-varying covariate. Form prior result, we know that directional funds have six significant covariates such as quarter flow (i.e. flow_Q), absolute and relative measures of recovery rate (i.e. RC and Dif_RC), one-year relatively risk-adjusted returns (i.e. Alpha_year), one-year return (Ret_year) and standard deviation, while the non-directional funds have five variables. Lastly, each individual fund has its ranking according to each covariate and we sum up the rankings to be its composite score of survival. The high score may reflect that the fund performs well in all dimension or balance in each dimension according the experience of the past year.

Table 21 Panel A demonstrates the attrition rate and out-of-sample performance in all directional funds. The attrition rate of all funds in one year is 12.7%, and that by mean of each filter ranges from 0.6% to 7.2% on average. The attrition rate of composite filter is obviously less than the other filters; it really provides the function of choosing live funds in short run. In performance side, the means of annual equal-weighted (i.e. EW) and value-weighted (i.e.VW) returns of the portfolio selected by the Sharpe ratio are 16.51%, 14.28%, respectively. The other filters choose the portfolios that the means of EW return range from 19.1% to 12.29% and those of VW return from 12.84% to 6.43%. The Sharpe ratio offers more consistent and less volatile returns over each calendar year than those selected by other filters. Especially, it does not only perform well even in the difficult equity market during 2000 to 2002 but also has better response to market shocks. For example, it is unlike the portfolios selected by risk-adjusted return (ie. Alpha_year) or composite score suffers from the large losses in 1998 and these filters choose the problem large funds. However, the Sharpe ratio and recover rate can choose the moderate large funds to pass the crisis, but the former can select the large funds with better gains as the market rebounds in next year than latter. The nature of both the Sharpe ratio and recovery rate is close and provides the function of risk control, but it is also important to satisfy the requirements of both profits and safety for the investors. The filters of the risk-adjusted returns and composite score even provides the less attrition rate, but their performances are too volatile and suffer from larger losses than overall funds during the market crash. Panel B demonstrates the results of all large directional funds and are consistent with overall funds. The attrition rate of the large funds is lower than overall funds, so the filters provide the effect of reducing attrition

for large funds is not evident. Merely, the good evidence of the Sharpe ratio may interpret as the result of the spurious control. Whether the overall funds or large fund sample, the EW and VW returns of the portfolio selected by the Sharpe ratio unlike other filters are close, in other words, it implies that the Sharpe ratio tends to select the large funds. Because the Sharpe ratio is an easy managing instrument of reviewing the performance for holding positions or screening the potential targets by the institutional investors. Hence, the large funds will maximize the Sharpe ratio as the objective in order to attract institutional investors' attention or satisfy their requirements. In contrary to small funds, it is no incentive to maximize the Sharpe ratio because small funds lack of enough reputation can not attract flows of institutional investors, even they have the good Sharpe ratio. However, it is still a good choice by means of using the Sharpe ratio to select more volatile large targets.

Panel C reports the results of all small directional funds and the effect of reducing attrition rate is apparent. According to survival analysis and observed behavior of small funds, the small funds belong to the group of high risk of hazard. The young directional funds in order to survival adopt high risky tactics to achieve an outstanding performance, and cumulate a reputation and scales quickly during the initial period. Therefore, it is meaningful that using these filters to screen some small funds with high risk. The attrition rate of all small funds in one year and two years are 17.8%, 30.2%, and those selected by composite score are 0.6% and 4.8% on average. The composite score choose the portfolio that means of the EW return in one year and two years are 17.74%, 15.27 % and those of the VW return are 17.62%, 14.85%. The performance and volatility of the portfolio selected by the Sharpe ratio and composite score are close. The Sharpe ratio that selected the small funds does not perform as well as that in large funds. The recovery rate provides the high ratio of mean return to standard deviation and less volatile returns among those of other filters. Moreover, it is a good choice by means of using the composite score to select directional small targets. The filter can effectively decrease the attrition rate and obtain better performance than overall small funds.

Table 22 Panels A and B, report the attrition rate and out-of-sample performance in all and large non-directional funds. The attrition rate of the all funds and large funds in one year are 10%, 6.1%, and that by mean of each filter ranges from 1.8% to 7.1%, 1.8% to 6.6% on average. The composite score provides the effect of reducing attrition for the

non-directional funds is lower than the directional funds; moreover, the effect for the large funds is not worth mentioning. In fact, the marginal effect of decreasing attrition rate is small because the non-directional funds with low risk attribute tend to be steady in trading. Adding some constrained conditions reduces the investment opportunity instead, it is verify that the performance of the large funds selected by composite score is worse than the other portfolios. The means of annual EW and VW returns of the portfolio selected by the composite score are 7.84%, 7.57%, respectively. The other filters choose the portfolios that the means of EW return range from 9.45% to 9.77% and those of VW return from 9.31% to 7.68%. Basically, the difference of performance between the mutual portfolios selected by each filter is small. The recovery rate offers less volatile returns over each calendar year than those selected by other filters. The large non-directional funds are sensitive to losses and risk; therefore, using the recovery rate to screen targets can work well.

Panel C reports the results of all small funds and the effect of reducing attrition rate is apparent. The performance of the portfolio selected by Alpha_year is the best among all filters. The means of annual EW and VW returns in one year are 14.39%, 15.86%, respectively. However, the non-directional small funds may take the strategy of maximizing the risk-adjusted returns on the premise that they have controlled the risk. They set up its reputations by means of successive good rankings among the same-style rivals, so, the filter of Alpha_year the in non-directional funds works better than in directional funds. The attrition rates of the portfolios selected by Alpha_year and Sharpe ratio are close; however, the reward of former is better than latter. Moreover, it is an alternative choice by means of using the information ratio to select the non-directional small targets.

## 6. Conclusion

This study investigates about key factors to survival of the fittest and using survival analysis to verify the relationship with these factors and hazard rate. We find some evidences about this issue.

(1).Different initial sizes lead to different investment philosophies as young age. Funds with the initial advantage of capital tend to regard stable rewards as their first goal, while the small funds start to change their behavior to be consistent with the former as long as they have reached the safe threshold of size. In other words, the successful funds with an initial small size will dynamically adjust their risk/reward relationship during the lifecycle phase

(2).Directional funds are more sensitive to size than non-directional funds. The strength of the initial size has a higher influence of the survival rate of directional funds than that of non-directional funds. The stability of the flows is the key to survival for small funds and change of favorite by investors is one factor which leads large funds to close. Most directional funds tend to small scales; therefore, they are more sensitive to the cash flow and size than non-directional funds. We find each one percent increase in quarter flow, the hazard of directional fund reduces by an estimated 32.4%. In contrast to the non-directional funds, the change of flow dose not affect the hazard, but the change of industrial favorable positioning (FAV) influence it instead. For each one percent raises in FAV, the hazard of the non-directional fund reduces by an estimated 42.9%.

(3).Opposing extremes of trading manners in the directional style have a survival space and a clear strategic position of risk is a necessary condition of successful funds. Adventurers of risk aggressively chase high rewards as their first goal, although they have no resistance against unanticipated shocks. They have a good ability of recovering severe losses once the market stabilizes.

(4).The recovering ability of maximum loss during the tolerant period given by investors becomes a necessary condition of survival. The hazard of funds that have recovered from the maximum losses is 64.8% of those without recovering. For each one percent increase in recovery rate, the hazard of funds reduces by an estimated 42.4%.

(5).The major reason of why the large funds, which choose to leave based upon keeping records or considering the market conditions, is that they show the signs of performance declines during the later period. As for the small funds without which did not reach the basic threshold, these are eliminated since they lack of performance and competitive power. The poor absolute (relative) performance and high volatility increase the risk of failure, however, the no effect of the standard deviation of active return. The result is consistent with BGP (2001) and Rough (2005) except the volatility of active return

(6).There is no obvious pattern to support the fact that successful funds are more alert to market shocks in advance, but they certainly have a better response to them.

(7).The characteristics of high water mark (HWK) and providing the audited report are indeed the important factors of hedge funds' survival. The funds that do not pay attention investor's right and have the potential agency conflicts will be eliminated from competition. The hazard of closure for those who have HWK provision is only about 51% of the hazard for those who do not have HWK. The result is consistent with Park (2007) but is contrary to Rough (2005). The audit significantly decreases the risk, the hazard for those who are willing to provide the audited financial report is only about 37% of those who does not provide them.

Lastly, we make use of the relevant covariates of survival function to construct a composite filter to select funds. The attrition rate of the portfolio selected by composite filter is obviously less than that of the Sharpe ratio. The composite filter provides the effect of reducing attrition rate of the non-directional funds is lower than the directional funds; likewise the effect of small fund sample is better than large funds sample. The portfolio of the directional funds selected by the Sharpe ratio does not only perform well even in the difficult equity market during 2000 to 2002 but also has better response to market shocks.

The good evidence of the Sharpe ratio may be interpreted as the result of the spurious control. Because the Sharpe ratio is an easy managing instrument of reviewing the performance for holding positions or screening the potential targets by the institutional investors. Thus, the large funds will maximize the Sharpe ratio as the objective in order to attract institutional investors' attention or satisfy their requirement. In contrary to

small funds, it is no incentive to maximize the Sharpe ratio because small funds lack of enough reputation can not attract flows of institutional investors, even they have the good Sharpe ratio. The evidence shows that using Sharpe ratio to select the small funds does not perform as well as that in large funds. Moreover, it is still a good choice by means of using the Sharpe ratio to select more volatile large targets. The other filters such recovery rate, composite filter, relative risk-adjusted return are properly applied to select small targets or non-directional funds.

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Table 1 Summary of the empirical results of the attrition rate and survivorship bias

| Authors | Data base | Sample period | Attrion rate (annual) |
|---|---|---|---|
| Fung & Hsieh (1997a;1997b;1998) | Pool data from LDC and TASS | 1 Sample period:1986-1996 (CTA)<br>2.Sample period:1994-1996(HFs) | 1.CTAs- 19%<br>2.CTAs motality-52.31% |
| Brown Goetzmann and Ibbotson (1999) | US offshore Funds Directory (hand-collected) | Sample period:1989-1995(HFs) | 1.CTAs- 20%<br>2.HFs-14% |
| Brown Goetzmann & Park (2001) | 1.Database: OFD (offshore funds directory )<br>2.TASS data(1989-1998) | 1 Sample period:1989-1998 | 1.CTAs- 20%<br>2.HFs-15%<br>3.attrition rate of managers--86.32% |
| Liang (1999 ; 2001) | 1.Database:HFR(1999)<br>2.Datebase:HFR & TASS (2001) | 1.Sample period:HFR---1993-1997/7<br>2.Sample period:TASS--- 1994-1998/7 | 1.HRF database - 2.17%<br>2.TASS database - 8.3% |
| Getmansky & Lo & Mei(2004) | 1.Database:TASS | 1.Sample period:1977/2-2004/8 | 1.HFs- 8.8% |
| Malkiel & Saha(2005) | 1.Database:TASS ( hedge funds)<br>2.Database: Lipper (Mutual funds) | 1.Sample period:---1994-2003 | 1.HFs- 17.46%<br>2.Mutual fund--5.765% |
| Baquero, Horst& Verbeek(2005) | 1.Database:TASS | 1.Sample period:---1994-2000 | 1.HFs= 8.64%( quarter 2.16%*4=8.64%)<br>2. Liquidation rate =5.2% (quarter 1.3%*4=5.2%) |
| Park(2007) | 1.Database:TASS | 1.Sample period:---1995-2004 | 1.HFs- 8.7%<br>2.real failure rate --3.1% |

| Authors | Data base | Sample period | Survivorship bias(annual) |
|---|---|---|---|
| Fung & Hsieh (1997a;1997b;1998) | Pool data from LDC and TASS | 1 Sample period:1986-1996 (CTA)<br>2.Sample period:1994-1996(HFs) | 1.CTAs- 3.54%<br>2.HFs--1.5% |
| Fung & Hsieh (2000;2001) | Pool data from LDC and TASS | 1.sample period:1986-1998(CTA)<br>2.sample period:1994-1998(HFs) | 1.CTAs- 3.6%<br>2.HFs- 3%(individual fund)<br>3.HFs-1.4%(fund of fund) |
| Brown Goetzmann and Ibbotson (1999) | US offshore Funds Directory (hand-collected) | Sample period:1989-1995(HFs) | 1.HFs- 3%(individual fund) |
| Ackermann, McEnally and Ravenscraft (1999) | Pool data from HFR and MAR | 1.Sample period:1995-1998 | 1.HFs- 0.16% |
| Liang (1999 ; 2001) | 1.Database:HFR(1999)<br>2.Datebase:HFR & TASS (2001) | 1.Sample period:HFR---1993-1997/7<br>2.Sample period:TASS--- 1994-1998/7 | 1.HRF- 0.39%<br>2.TASS- 2.24% |
| Bares, Gibson& Gyger (2001) | FRM | 1.Sample period:1994-1999/4 | 1.HFs= 1.32% |
| Amin& Kat ( 2003) | TASS | 1.Sample period: 1994/6-2001/5 | 1.HFs= 1.542%<br>2.survivorship bias range4%-5%(small, young, or used leverage) |
| Malkiel & Saha(2005) | TASS | 1.Sample period(survivorship bias): 1996-2003 | 1.HFs= 4.42%(survivor-total )<br>2.HFs=8.35%(survivor-defunct ) |
| Rouah (2005) | HFR | 1.Sample period: 1994/1-2003/12 | 1.HFs=1.51% (survivor-defunct ) |

Table2: Description of size, performance, risk and managers' skills for leading funds.
Panel A: Description of size and performance

| Group | Style | age (year) | Fund Size (USD million) Terminal AUM | Rank of Terminal AUM | Initial AUM | quantile | Performance (annual return %) Mean return | Mean active return | Jensen's alpha | | Alpha2* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Directional funds | Emerging Markets | 8.7 | 1,273 | rank1 | 4.9 | 55% | 44.0 | 33.5 | 21.3 | * | 18.7 | |
| | | 10.3 | 840 | rank2 | 25.9 | 90% | 7.9 | -1.1 | -1.1 | | 7.8 | |
| | | 5.3 | 627 | rank3 | 16.2 | 82% | 13.1 | -0.2 | 3.0 | | -21.4 | *** |
| | | 7.7 | 502 | rank4 | 108.2 | 99% | 14.4 | 7.7 | 8.8 | * | 30.1 | *** |
| | | 7.5 | 426 | rank5 | 26.0 | 90% | 8.1 | 1.9 | 2.7 | | 0.8 | |
| | Global Macro | 8.1 | 3,319 | rank1 | 25.0 | 89% | 8.2 | -5.5 | 4.5 | *** | 5.2 | * |
| | | 5.6 | 2,490 | rank2 | 25.4 | 89% | 9.0 | -4.9 | 3.7 | | 9.3 | |
| | | 11.3 | 1,840 | rank3 | 48.0 | 95% | 9.1 | -4.8 | 4.9 | | 2.9 | |
| | | 7.7 | 1,382 | rank4 | 7.9 | 67% | 12.3 | -0.2 | 5.6 | | 3.8 | |
| | | 8.8 | 1,004 | rank5 | 0.7 | 15% | 37.2 | 23.9 | 29.6 | *** | 11.0 | |
| | Long/Short Equity Hedge | 9.2 | 2,720 | rank1 | 6.3 | 63% | 12.2 | -0.9 | 6.4 | *** | 1.6 | |
| | | 6.9 | 1,303 | rank2 | 53.2 | 96% | 17.8 | 6.2 | 10.1 | *** | 3.3 | |
| | | 8.2 | 1,241 | rank3 | 1.3 | 26% | 24.5 | 11.5 | 17.2 | *** | 19.4 | *** |
| | | 10.5 | 843 | rank4 | 37.5 | 93% | 15.1 | 2.1 | 6.4 | * | 5.8 | |
| | | 9.9 | 789 | rank5 | 29.0 | 91% | 20.6 | 6.7 | 13.1 | *** | 17.2 | *** |
| | Managed Futures | 10.7 | 3,969 | rank1 | 9.7 | 71% | 10.5 | 3.2 | 3.4 | | 3.9 | |
| | | 5.9 | 2,137 | rank2 | 15.5 | 81% | 22.4 | 15.4 | 13.6 | * | 10.4 | |
| | | 8.7 | 2,005 | rank3 | 6.7 | 65% | 21.0 | 12.0 | 10.8 | *** | 8.5 | |
| | | 6.0 | 1,115 | rank4 | 20.6 | 86% | 13.2 | 5.9 | 5.2 | | 0.7 | |
| | | 9.9 | 1,079 | rank5 | 16.1 | 81% | 15.8 | 8.7 | 8.7 | * | 1.0 | |
| | Multi_strategy | 9.4 | 3,433 | rank1 | 4.0 | 52% | 13.1 | 0.7 | 7.1 | *** | 9.9 | *** |
| | | 9.9 | 2,117 | rank2 | 7.0 | 65% | 12.0 | -0.2 | 3.6 | * | 12.1 | *** |
| | | 5.2 | 2,005 | rank3 | 45.9 | 95% | 12.6 | 2.8 | 11.1 | *** | 5.6 | * |
| | | 10.2 | 1,815 | rank4 | 5.8 | 62% | 16.2 | 4.4 | 10.0 | *** | 12.7 | *** |
| | | 9.1 | 1,543 | rank5 | 10.0 | 72% | 8.9 | -2.9 | 4.6 | *** | 6.5 | *** |
| Nondirectional funds | Convertible Arbitrage | 6.9 | 3,664 | rank1 | 80.9 | 97% | 20.6 | 11.2 | 10.6 | * | 5.5 | |
| | | 8.3 | 2,004 | rank2 | 9.7 | 65% | 13.1 | 2.9 | 4.3 | *** | 6.8 | *** |
| | | 10.6 | 1,619 | rank3 | 5.0 | 45% | 15.0 | 5.0 | 6.8 | *** | 6.2 | |
| | | 9.4 | 956 | rank4 | 11.7 | 72% | 16.4 | 5.4 | 6.7 | *** | 11.0 | *** |
| | | 6.9 | 950 | rank5 | 30.8 | 88% | 16.7 | 7.3 | 8.8 | *** | 1.1 | |
| | Equity Market Neutral | 9.8 | 2,201 | rank1 | 3.6 | 38% | 12.1 | 1.0 | 5.5 | *** | 3.9 | *** |
| | | 7.4 | 627 | rank2 | 14.5 | 75% | 14.4 | 4.4 | 5.7 | *** | 3.9 | * |
| | | 10.6 | 449 | rank3 | 7.9 | 60% | 12.8 | 2.6 | 6.8 | *** | 4.6 | *** |
| | | 7.5 | 251 | rank4 | 9.8 | 65% | 8.5 | -1.5 | 5.1 | *** | 5.3 | *** |
| | | 5.9 | 222 | rank5 | 20.6 | 82% | 6.9 | -2.8 | -1.7 | | -1.4 | |
| | Event Driven | 11.5 | 3,749 | rank1 | 18.3 | 80% | 12.8 | 1.0 | 5.3 | *** | 4.8 | *** |
| | | 7.9 | 3,292 | rank2 | 5.0 | 45% | 11.5 | 1.1 | 5.6 | *** | 1.2 | |
| | | 9.9 | 2,500 | rank3 | 79.9 | 96% | 11.8 | -0.4 | 4.8 | *** | 6.3 | *** |
| | | 10.8 | 2,010 | rank4 | 21.0 | 82% | 14.3 | 3.3 | 3.9 | * | -2.1 | |
| | | 9.7 | 1,582 | rank5 | 4.4 | 42% | 14.5 | 2.4 | 7.3 | *** | 2.9 | |
| | Fixed Income Arbitrage | 8.4 | 1,692 | rank1 | 28.0 | 88% | 10.8 | 4.4 | 6.2 | * | 1.6 | |
| | | 11.4 | 1,679 | rank2 | 37.8 | 90% | 10.8 | 3.9 | 3.4 | *** | 5.3 | *** |
| | | 8.3 | 1,159 | rank3 | 21.5 | 83% | 8.0 | 1.7 | -1.0 | | 21.0 | *** |
| | | 10.5 | 866 | rank4 | 24.8 | 86% | 12.2 | 5.1 | 1.9 | | 8.6 | *** |
| | | 6.8 | 841 | rank5 | 14.0 | 75% | 12.7 | 7.3 | 8.8 | *** | 7.8 | * |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Panel B: Description of Risk

| Group | Style | age (year) | Rank of Terminal AUM | Risk (%) standard deviation | β | | Maximal loss (monthly) | Maximal drawdown | Average drawdown |
|---|---|---|---|---|---|---|---|---|---|
| Directional funds | Emerging Markets | 8.7 | rank1 | 15.837 | 2.745 | *** | -63.79 | -25.60 | -12.25 |
| | | 10.3 | rank2 | 6.016 | 0.991 | *** | -27.40 | -17.72 | -8.12 |
| | | 5.3 | rank3 | 4.104 | 0.696 | *** | -5.73 | -9.94 | -3.96 |
| | | 7.7 | rank4 | 4.521 | 0.684 | *** | -33.98 | -10.89 | -2.26 |
| | | 7.5 | rank5 | 5.164 | 0.740 | *** | -17.31 | -18.96 | -9.96 |
| | Global Macro | 8.1 | rank1 | 1.328 | 0.020 | | -5.47 | -5.47 | -2.44 |
| | | 5.6 | rank2 | 2.852 | 0.223 | | -6.07 | -14.18 | -4.00 |
| | | 11.3 | rank3 | 2.991 | 0.027 | | -5.12 | -15.01 | -5.53 |
| | | 7.7 | rank4 | 4.259 | 0.358 | * | -11.93 | -12.64 | -5.96 |
| | | 8.8 | rank5 | 9.080 | 0.410 | | -28.82 | -16.83 | -8.67 |
| | Long/Short Equity Hedge | 9.2 | rank1 | 1.897 | 0.222 | *** | -3.55 | -3.87 | -1.66 |
| | | 6.9 | rank2 | 2.840 | 0.536 | *** | -2.79 | -4.44 | -1.55 |
| | | 8.2 | rank3 | 3.376 | 0.398 | *** | -9.09 | -13.67 | -3.80 |
| | | 10.5 | rank4 | 3.107 | 0.533 | *** | -6.57 | -5.43 | -3.19 |
| | | 9.9 | rank5 | 2.675 | 0.358 | *** | -13.25 | -19.21 | -2.87 |
| | Managed Futures | 10.7 | rank1 | 4.267 | 0.968 | *** | -10.14 | -13.90 | -5.27 |
| | | 5.9 | rank2 | 6.627 | 1.456 | *** | -13.62 | -21.01 | -8.34 |
| | | 8.7 | rank3 | 5.510 | 1.228 | *** | -9.60 | -17.90 | -6.56 |
| | | 6.0 | rank4 | 5.261 | 1.166 | *** | -9.73 | -21.46 | -8.79 |
| | | 9.9 | rank5 | 4.960 | 1.020 | *** | -11.16 | -17.96 | -6.75 |
| | Multi_strategy | 9.4 | rank1 | 1.707 | 0.255 | *** | -8.78 | -4.09 | -1.09 |
| | | 9.9 | rank2 | 2.276 | 0.542 | *** | -16.95 | -6.91 | -1.51 |
| | | 5.2 | rank3 | 1.700 | -0.177 | | -2.75 | -4.97 | -1.47 |
| | | 10.2 | rank4 | 1.915 | 0.292 | *** | -9.12 | -5.82 | -1.82 |
| | | 9.1 | rank5 | 0.753 | 0.078 | *** | -2.51 | -5.42 | -3.07 |
| Nondirectional funds | Convertible Arbitrage | 6.9 | rank1 | 3.401 | 1.087 | *** | -6.19 | -9.76 | -2.89 |
| | | 8.3 | rank2 | 1.458 | 0.791 | *** | -7.94 | -11.81 | -2.50 |
| | | 10.6 | rank3 | 2.355 | 0.714 | *** | -8.03 | -12.08 | -4.02 |
| | | 9.4 | rank4 | 1.871 | 0.820 | *** | -8.60 | -12.49 | -2.21 |
| | | 6.9 | rank5 | 2.160 | 0.750 | *** | -1.96 | -2.33 | -1.50 |
| | Equity Market Neutral | 9.8 | rank1 | 0.805 | 0.383 | *** | -0.48 | -0.59 | -0.25 |
| | | 7.4 | rank2 | 1.134 | 0.807 | *** | -0.55 | -0.74 | -0.15 |
| | | 10.6 | rank3 | 0.803 | 0.335 | *** | -0.44 | -0.46 | -0.20 |
| | | 7.5 | rank4 | 0.399 | 0.003 | | 0.00 | 0.00 | 0.00 |
| | | 5.9 | rank5 | 1.241 | 0.831 | *** | -2.12 | -2.18 | -1.39 |
| | Event Driven | 11.5 | rank1 | 1.053 | 0.411 | *** | -3.16 | -4.91 | -1.73 |
| | | 7.9 | rank2 | 1.100 | 0.351 | *** | -1.83 | -2.58 | -1.18 |
| | | 9.9 | rank3 | 1.243 | 0.375 | *** | -4.00 | -9.92 | -3.26 |
| | | 10.8 | rank4 | 2.202 | 0.919 | *** | -6.70 | -12.21 | -1.97 |
| | | 9.7 | rank5 | 1.245 | 0.410 | *** | -1.92 | -2.74 | -1.51 |
| | Fixed Income Arbitrage | 8.4 | rank1 | 2.119 | 0.366 | * | -8.81 | -17.66 | -3.32 |
| | | 11.4 | rank2 | 1.601 | 1.182 | *** | -9.96 | -15.46 | -4.36 |
| | | 8.3 | rank3 | 3.204 | 1.982 | *** | -30.12 | -2.12 | -1.65 |
| | | 10.5 | rank4 | 2.527 | 1.964 | *** | -16.20 | -30.75 | -6.21 |
| | | 6.8 | rank5 | 1.666 | 0.335 | * | -5.34 | -7.60 | -1.36 |

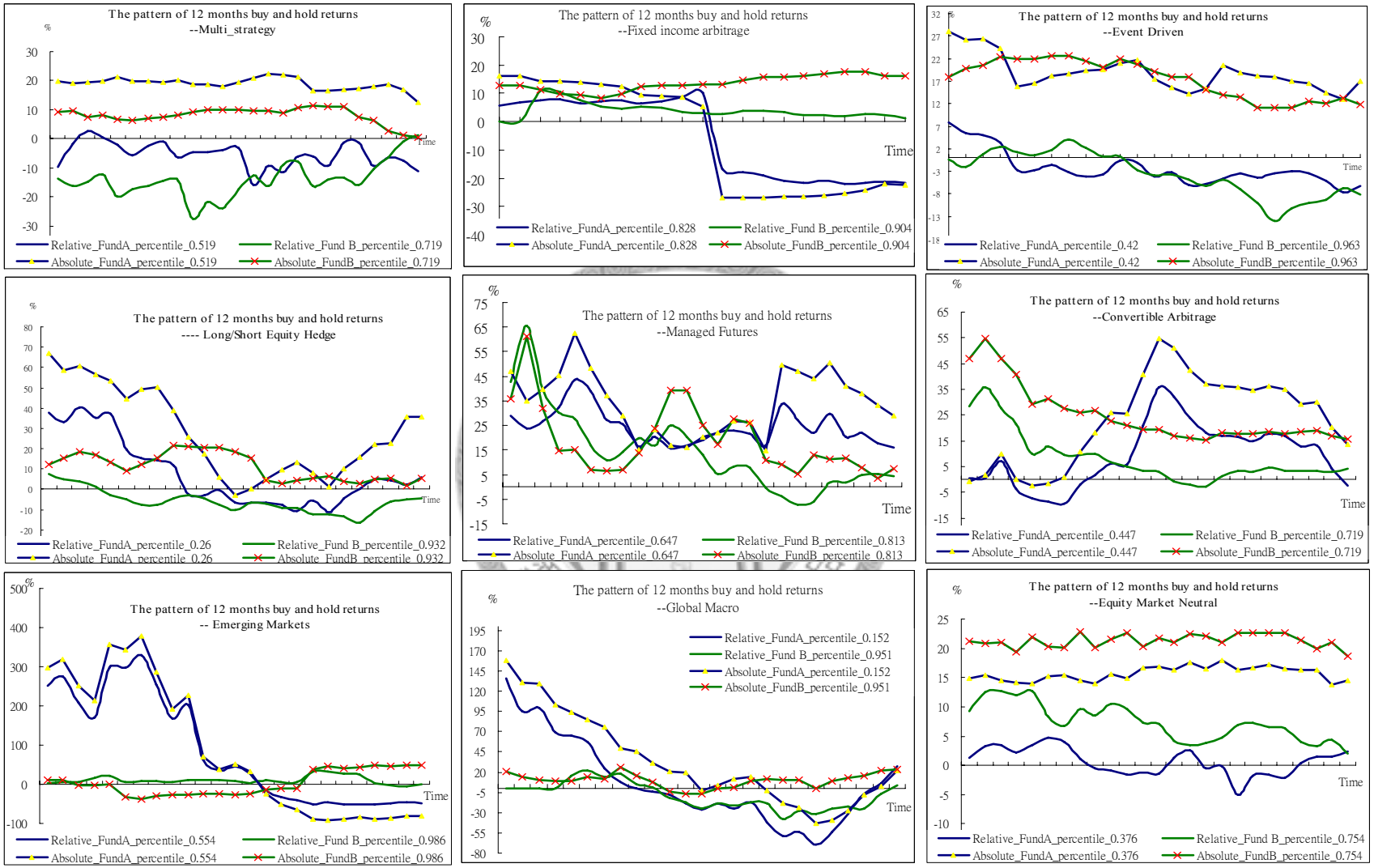
Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Panel C: Description of manager's skill.

| Group | Style | age (year) | Rank of Terminal AUM | Selective capability (annual return %) Jensen's alpha | Alpha2 | Market timing and protection (%) β1 | β2 | Recoverable time for losses (month) Maximum loss | Maximum drawdown | Average drawdown |
|---|---|---|---|---|---|---|---|---|---|---|
| Directional funds | Emerging Markets | 8.7 | rank1 | 21.3 * | 18.7 | 2.816 *** | 0.124 | 18.0 | 73.0 | 20.5 |
| | | 10.3 | rank2 | -1.1 | 7.8 | 0.770 *** | -0.407 * | 15.0 | 14.0 | 20.2 |
| | | 5.3 | rank3 | 3.0 | -21.4 *** | 1.298 *** | 1.537 *** | - | - | 2.2 |
| | | 7.7 | rank4 | 8.8 * | 30.1 *** | 0.068 | -1.018 *** | 15.0 | 18.0 | 3.2 |
| | | 7.5 | rank5 | 2.7 | 0.8 | 0.793 *** | 0.089 | 4.0 | 40.0 | 13.0 |
| | Global Macro | 8.1 | rank1 | 4.5 *** | 5.2 * | 0.000 | -0.048 | 3.0 | 3.0 | 2.9 |
| | | 5.6 | rank2 | 3.7 | 9.3 | -0.017 | -0.630 | 2.0 | 18.0 | 4.9 |
| | | 11.3 | rank3 | 4.9 | 2.9 | 0.087 | 0.142 | 7.0 | 8.0 | 6.0 |
| | | 7.7 | rank4 | 5.6 | 3.8 | 0.422 * | 0.139 | 6.0 | - | 6.8 |
| | | 8.8 | rank5 | 29.6 *** | 11.0 | 1.015 * | 1.290 * | 3.0 | 12.0 | 3.6 |
| | Long/Short Equity Hedge | 9.2 | rank1 | 6.4 *** | 1.6 | 0.369 *** | 0.378 *** | 12.0 | 2.0 | 3.8 |
| | | 6.9 | rank2 | 10.1 *** | 3.3 | 0.743 *** | 0.520 *** | 3.0 | 7.0 | 2.6 |
| | | 8.2 | rank3 | 17.2 *** | 19.4 *** | 0.332 * | -0.171 | 4.0 | 3.0 | 2.3 |
| | | 10.5 | rank4 | 6.4 * | 5.8 | 0.552 *** | 0.048 | 2.0 | 7.0 | 4.8 |
| | | 9.9 | rank5 | 13.1 *** | 17.2 *** | 0.231 * | -0.327 | 7.0 | 7.0 | 2.1 |
| | Managed Futures | 10.7 | rank1 | 3.4 | 3.9 | 0.952 *** | -0.035 | 8.0 | - | 4.2 |
| | | 5.9 | rank2 | 13.6 * | 10.4 | 1.537 *** | 0.189 | 3.0 | - | 4.0 |
| | | 8.7 | rank3 | 10.8 *** | 8.5 | 1.285 *** | 0.137 | 3.0 | 3.0 | 2.9 |
| | | 6.0 | rank4 | 5.2 | 0.7 | 1.278 *** | 0.260 | 4.0 | 6.0 | 3.4 |
| | | 9.9 | rank5 | 8.7 * | 1.0 | 1.223 *** | 0.453 * | 8.0 | 3.0 | 5.2 |
| | Multi_strategy | 9.4 | rank1 | 7.1 *** | 9.9 *** | 0.143 | -0.293 | 5.0 | 5.0 | 3.0 |
| | | 9.9 | rank2 | 3.6 * | 12.1 *** | 0.198 * | -0.896 *** | 11.0 | 5.0 | 2.7 |
| | | 5.2 | rank3 | 11.1 *** | 5.6 * | 0.072 | 0.858 *** | 4.0 | 4.0 | 1.8 |
| | | 10.2 | rank4 | 10.0 *** | 12.7 *** | 0.183 * | -0.285 | 5.0 | 5.0 | 3.2 |
| | | 9.1 | rank5 | 4.6 *** | 6.5 *** | -0.002 | -0.201 * | 7.0 | 6.0 | 3.5 |
| Nondirectional funds | Convertible Arbitrage | 6.9 | rank1 | 10.6 * | 5.5 | 1.481 *** | 0.696 | 4.0 | 3.0 | 2.0 |
| | | 8.3 | rank2 | 4.3 *** | 6.8 *** | 0.594 *** | -0.352 * | 3.0 | 6.0 | 2.3 |
| | | 10.6 | rank3 | 6.8 *** | 6.2 | 0.763 *** | 0.087 | 11.0 | 9.0 | 7.8 |
| | | 9.4 | rank4 | 6.7 *** | 11.0 *** | 0.477 * | -0.617 * | 3.0 | 6.0 | 2.0 |
| | | 6.9 | rank5 | 8.8 *** | 1.1 | 1.343 *** | 1.047 * | - | 3.0 | 4.0 |
| | Equity Market Neutral | 9.8 | rank1 | 5.5 *** | 3.9 *** | 0.509 *** | 0.611 * | 2.0 | 1.0 | 1.0 |
| | | 7.4 | rank2 | 5.7 *** | 3.9 * | 0.961 *** | 0.753 | 2.0 | 1.0 | 1.0 |
| | | 10.6 | rank3 | 6.8 *** | 4.6 *** | 0.516 *** | 0.675 * | 1.0 | 1.0 | 1.0 |
| | | 7.5 | rank4 | 5.1 *** | 5.3 *** | -0.014 | -0.084 | - | - | - |
| | | 5.9 | rank5 | -1.7 | -1.4 | 0.806 *** | -0.222 | 17.0 | - | 29.0 |
| | Event Driven | 11.5 | rank1 | 5.3 *** | 4.8 *** | 0.446 *** | 0.058 | 8.0 | 6.0 | 2.1 |
| | | 7.9 | rank2 | 5.6 *** | 1.2 | 0.678 *** | 0.492 *** | 4.0 | 4.0 | 2.8 |
| | | 9.9 | rank3 | 4.8 *** | 6.3 *** | 0.273 * | -0.160 | 11.0 | 10.0 | 4.5 |
| | | 10.8 | rank4 | 3.9 * | -2.1 | 1.368 *** | 0.722 *** | 7.0 | 7.0 | 2.6 |
| | | 9.7 | rank5 | 7.3 *** | 2.9 | 0.732 *** | 0.507 *** | 5.0 | 4.0 | 2.4 |
| | Fixed Income Arbitrage | 8.4 | rank1 | 6.2 * | 1.6 | 0.971 * | 0.821 | 13.0 | 24.0 | 4.6 |
| | | 11.4 | rank2 | 3.4 *** | 5.3 *** | 0.934 *** | -0.348 | 5.0 | 15.0 | 4.0 |
| | | 8.3 | rank3 | -1.0 | 21.0 *** | -0.932 * | -3.946 *** | 32.0 | 1.0 | 20.0 |
| | | 10.5 | rank4 | 1.9 | 8.6 *** | 1.083 *** | -1.239 *** | 5.0 | 21.0 | 5.0 |
| | | 6.8 | rank5 | 8.8 *** | 7.8 * | 0.468 | 0.178 | 10.0 | 9.0 | 2.0 |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Figure1.Ttrend of the 12-months buy and hold returns of each style from inception to the end of the third year.




Note: Relative_fundA_percentile_*x* represents the 12 months excess returns of funds A, which the quantile of initial AUM is *x*. The active return is defined as buy and hold return of funds subtract corresponding CS/Tremont style benchmarks. Absolute_fundA_percentile_*x* represents the 12 months buy and hold return.

Figure2.The time series trend of the 12-month buy and hold return for each style from January 1997 to November 2004.

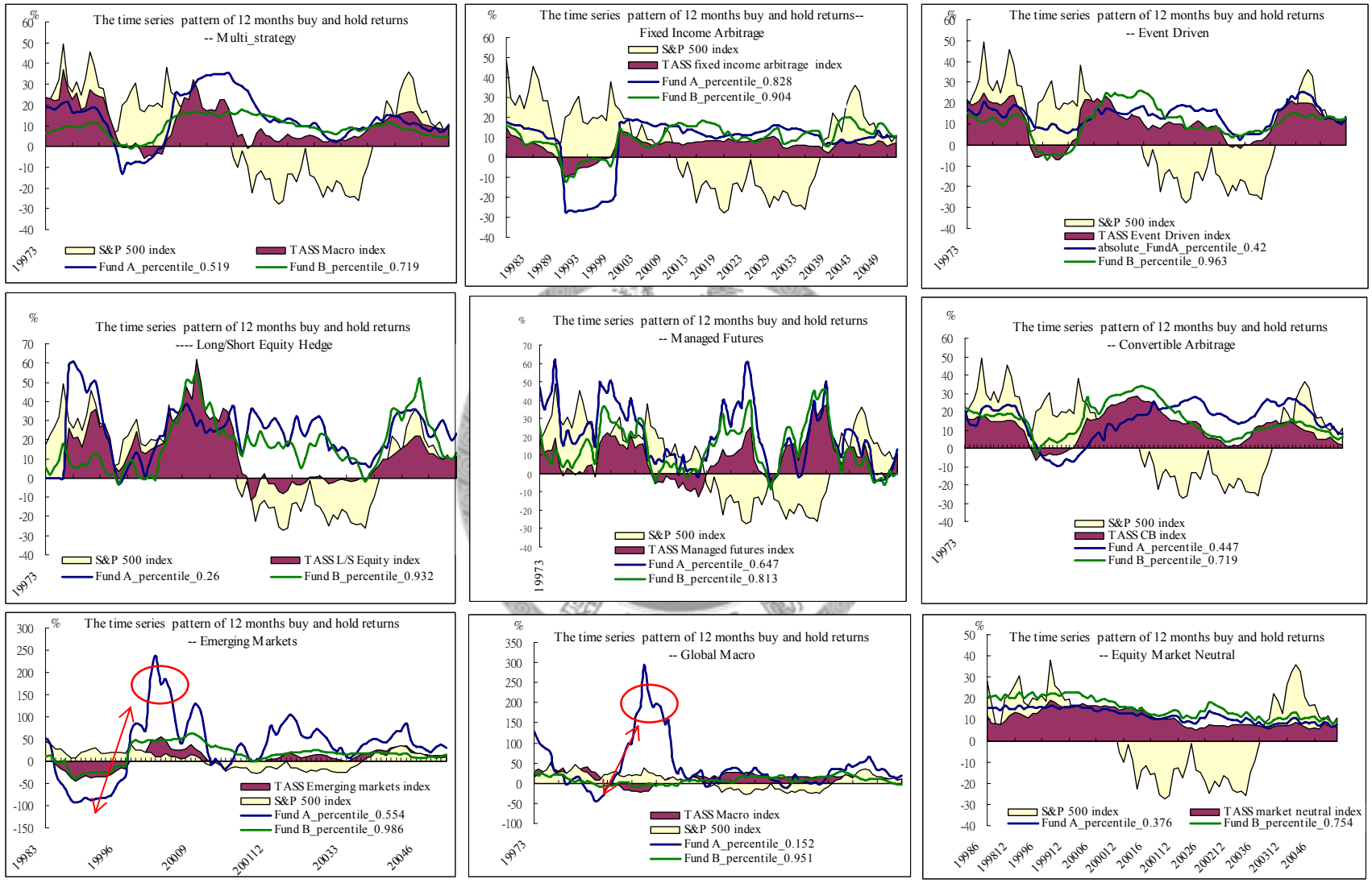
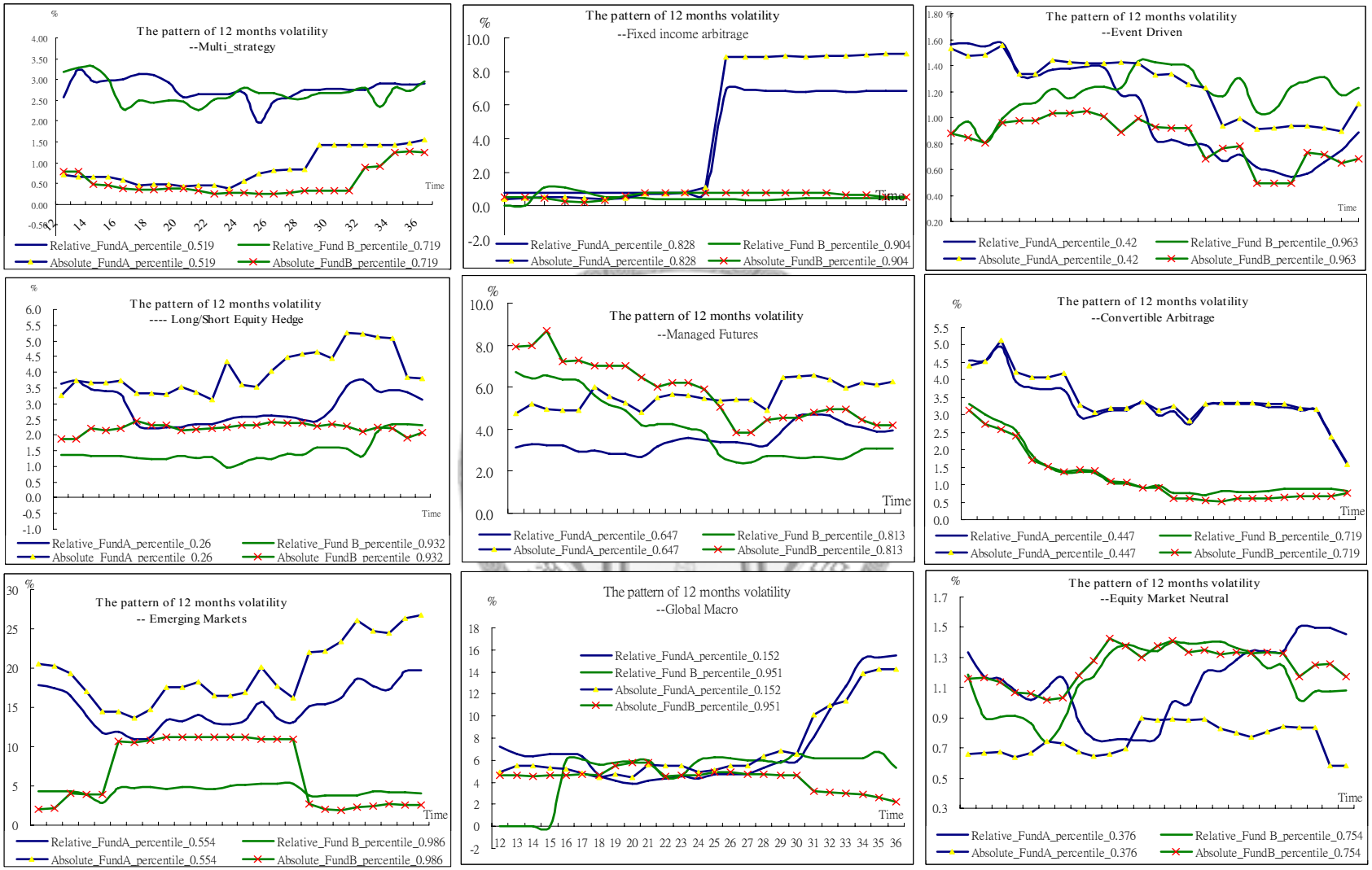


Figure3. Trend of the standard deviation of monthly returns prior to 12-months from inception to the end of the third year.




Note: Relative_fundA_percentile_*x* represents the standard deviation of monthly active return over one year for funds A, which the quantile of initial AUM is *x*. The active return is defined as buy and hold return of funds subtract corresponding CS/Tremont style benchmarks. Absolute_fundA_percentile_*x* represents the standard deviation of monthly return over one year for funds A

Figure4. Trend of the standard deviation of monthly return prior to 12-months from January 1997 to November 2004.

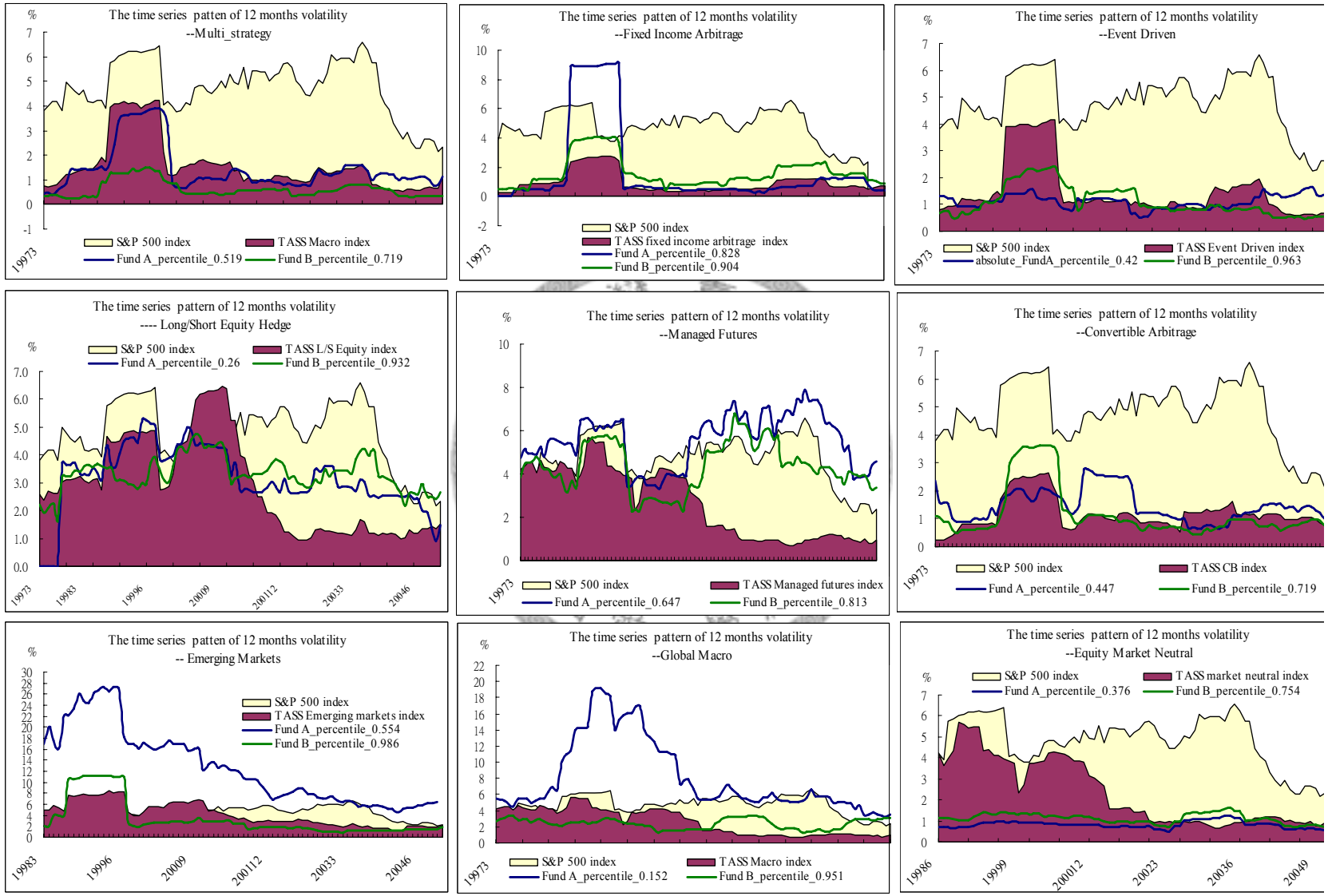


Table3: Percentiles of the final AUMs for live funds and defunct funds.

Unit: $ US thousand

| Live funds | | Sample size | P10 | P25 | P50 | P75 | P90 | P95 |
|---|---|---|---|---|---|---|---|---|
| Total | All | 1,432 | 4,566 | 14,981 | 53,505 | 179,869 | 452,300 | 818,600 |
| | Inception before 2000 | 654 | 6,681 | 20,820 | 75,102 | 244,000 | 647,000 | 1,290,000 |
| Directional style | All | 960 | 3,930 | 11,785 | 45,264 | 146,289 | 400,230 | 711,000 |
| | Inception before 2000 | 460 | 6,173 | 18,504 | 61,464 | 205,188 | 496,244 | 1,096,900 |
| Nondirectional style | All | 472 | 6,991 | 22,003 | 81,909 | 239,469 | 610,182 | 984,212 |
| | Inception before 2000 | 194 | 9,522 | 41,900 | 120,838 | 300,200 | 878,574 | 1,619,000 |

| Defunct funds | | Sample size | P10 | P25 | P50 | P75 | P90 | P95 |
|---|---|---|---|---|---|---|---|---|
| Total | All | 1,086 | 904 | 2,300 | 7,923 | 24,948 | 76,544 | 146,520 |
| | Inception before 2000 | 877 | 790 | 2,250 | 7,869 | 24,300 | 79,919 | 152,380 |
| Directional style | All | 815 | 665 | 1,911 | 5,575 | 19,500 | 59,807 | 101,915 |
| | Inception before 2000 | 666 | 623 | 1,969 | 5,702 | 19,326 | 58,641 | 101,915 |
| Nondirectional style | All | 271 | 2,000 | 5,300 | 15,000 | 53,162 | 146,520 | 366,000 |
| | Inception before 2000 | 211 | 1,956 | 4,710 | 14,955 | 56,344 | 151,850 | 321,519 |

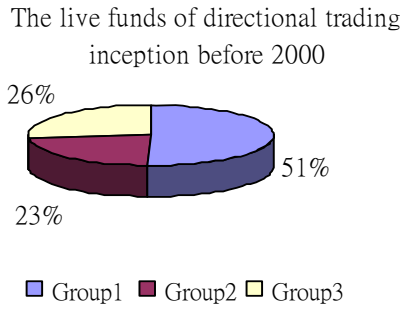
| Liquidated funds | | Sample size | P10 | P25 | P50 | P75 | P90 | P95 |
|---|---|---|---|---|---|---|---|---|
| Total | All | 594 | 657 | 1,995 | 5,870 | 20,525 | 58,641 | 99,669 |
| | Inception before 2000 | 463 | 614 | 1,969 | 5,650 | 21,378 | 67,892 | 109,454 |
| Directional style | All | 445 | 430 | 1,519 | 4,184 | 13,740 | 42,091 | 70,776 |
| | Inception before 2000 | 353 | 410 | 1,600 | 4,500 | 13,789 | 44,438 | 76,544 |
| Nondirectional style | All | 149 | 1,956 | 5,300 | 15,066 | 51,800 | 112,830 | 152,937 |
| | Inception before 2000 | 110 | 1,762 | 4,588 | 16,851 | 55,001 | 126,071 | 152,937 |

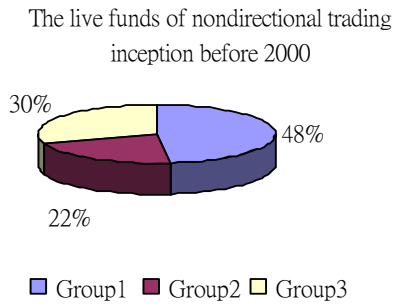
| No reporting funds | | Sample size | P10 | P25 | P50 | P75 | P90 | P95 |
|---|---|---|---|---|---|---|---|---|
| Total | All | 319 | 1,377 | 3,792 | 13,900 | 51,500 | 182,819 | 366,000 |
| | Inception before 2000 | 254 | 1,500 | 3,780 | 13,077 | 44,802 | 167,400 | 321,519 |
| Directional style | All | 239 | 1,300 | 3,279 | 11,700 | 43,062 | 116,330 | 220,727 |
| | Inception before 2000 | 189 | 1,305 | 3,200 | 11,098 | 35,332 | 115,374 | 209,088 |
| Nondirectional style | All | 80 | 1,844 | 7,591 | 16,425 | 60,850 | 424,870 | 830,560 |
| | Inception before 2000 | 65 | 2,087 | 7,835 | 16,300 | 60,000 | 433,780 | 790,000 |

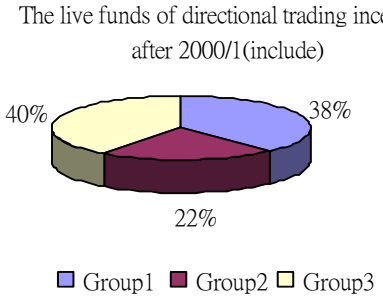
Table4: Sample size and median of the initial and last AUMs in each group

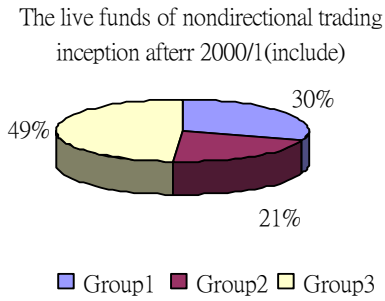
Panel A: Sample size in each group

| | Sample size of directional trading | | | | | Sample size of nondirectional trading | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Live funds | | | | | | | | | | | |
| Inception date | Group1 | Group2 | Group3 | Total | % | Group1 | Group2 | Group3 | Total | % | All |
| Before 2000 | 232 | 107 | 121 | 460 | 70.3% | 93 | 42 | 59 | 194 | 29.7% | 654 |
| After 2000/1 (include) | 189 | 111 | 200 | 500 | 64.3% | 84 | 58 | 136 | 278 | 35.7% | 778 |
| Total | 421 | 218 | 321 | 960 | 67.0% | 177 | 100 | 195 | 472 | 33.0% | 1432 |
| Defunct funds | | | | | | | | | | | |
| Inception date | Group1 | Group2 | Group3 | Total | % | Group1 | Group2 | Group3 | Total | % | All |
| Before 2000 | 66 | 100 | 500 | 666 | 75.9% | 23 | 33 | 155 | 211 | 24.1% | 877 |
| After 2000/1 (include) | 16 | 22 | 111 | 149 | 71.3% | 5 | 7 | 48 | 60 | 28.7% | 209 |
| Total | 82 | 122 | 611 | 815 | 75.0% | 28 | 40 | 203 | 271 | 25.0% | 1086 |
| Defunct funds | Liquidated | No report | No contact | Closed or Merged | Total | Liquidated | No report | No contact | Closed or Merged | Total | All |
| Before 2000 | 353 | 189 | 103 | 21 | 666 | 110 | 65 | 28 | 8 | 211 | 877 |
| After 2000/1 (include) | 92 | 50 | 6 | 1 | 149 | 39 | 15 | 3 | 3 | 60 | 209 |
| Total | 445 | 239 | 109 | 22 | 815 | 149 | 80 | 31 | 11 | 271 | 1086 |




Panel B: Proportion of numbers of funds with different initial sizes to all funds in each group

| Inception | | Directional style | | | | Nondirectional style | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Live funds | Group1 | Group2 | Group3 | Total | Group1 | Group2 | Group3 | Total |
| Before year 2000 | group0_1 | 27.2% | 19% | 7% | 19.8% | 8% | 2% | 3% | 5.2% |
| | group0_2 | 72.8% | 81% | 93% | 80.2% | 92% | 98% | 97% | 94.8% |
| | Defunct funds | | | | | | | | |
| | group0_1 | 50.0% | 22% | 6% | 12.6% | 17% | 15% | 3% | 6.6% |
| | group0_2 | 50.0% | 78% | 94% | 87.4% | 83% | 85% | 97% | 93.4% |
| After 2000/1 (include) | Live funds | | | | | | | | |
| | group0_1 | 32.8% | 22% | 1% | 17.6% | 23% | 5% | 4% | 9.7% |
| | group0_2 | 67.2% | 78% | 99% | 82.4% | 77% | 95% | 96% | 90.3% |
| | Defunct funds | | | | | | | | |
| | group0_1 | 43.8% | 18% | 4% | 10.1% | 20% | 0% | 2% | 3.3% |
| | group0_2 | 56.3% | 82% | 96% | 89.9% | 80% | 100% | 98% | 96.7% |

Panel C: Mean of the initial AUM in each group

| Unit: US thousand | Directional style | | | Nondirectional style | | |
|---|---|---|---|---|---|---|
| Inception before 2000 | | | | | | |
| Live funds | Group1 | Group2 | Group3 | Group1 | Group2 | Group3 |
| group0_1 | 54,111 | 35,714 | 27,186 | 86,647 | 91,062 | 105,967 |
| group0_2 | 5,974 | 4,289 | 3,967 | 12,026 | 6,220 | 5,859 |
| Defunct funds | | | | | | |
| group0_1 | 69,999 | 50,675 | 34,799 | 109,261 | 113,999 | 74,466 |
| group0_2 | 7,025 | 5,911 | 3,715 | 19,396 | 9,430 | 7,853 |
| After 2000/1 (include) | | | | | | |
| Live funds | | | | | | |
| group0_1 | 67,687 | 37,269 | 23,189 | 140,739 | 78,118 | 72,279 |
| group0_2 | 7,488 | 5,537 | 3,060 | 17,225 | 18,679 | 8,337 |
| Defunct funds | | | | | | |
| group0_1 | 157,114 | 32,302 | 20,033 | 588,438 | - | 156,296 |
| group0_2 | 8,749 | 5,826 | 3,416 | 24,631 | 22,295 | 8,245 |

Panel D: Mean of the last AUM in each group

| Unit: US thousand | Directional style | | | Nondirectional style | | |
|---|---|---|---|---|---|---|
| Inception before 2000 | | | | | | |
| Live funds | Group1 | Group2 | Group3 | Group1 | Group2 | Group3 |
| group0_1 | 495,353 | 37,191 | 9,809 | 1,077,286 | 115,000 | 27,909 |
| group0_2 | 388,428 | 34,533 | 8,261 | 625,154 | 88,841 | 20,495 |
| Defunct funds | | | | | | |
| group0_1 | 156,872 | 37,730 | 8,249 | 339,198 | 99,451 | 22,430 |
| group0_2 | 167,138 | 32,661 | 5,108 | 408,522 | 86,701 | 12,758 |
| After 2000/1 (include) | | | | | | |
| Live funds | | | | | | |
| group0_1 | 332,400 | 42,096 | 12,847 | 542,071 | 103,070 | 31,583 |
| group0_2 | 225,743 | 34,925 | 7,568 | 443,402 | 91,267 | 19,896 |
| Defunct funds | | | | | | |
| group0_1 | 337,681 | 35,058 | 9,138 | 1,447,495 | - | 32,721 |
| group0_2 | 97,832 | 35,507 | 4,953 | 468,577 | 66,185 | 15,092 |

**Table 5:** The proportion of funds with each characteristic among fund groups.

**Panel A: Sample of all funds**

| | All funds | | | Directional style | | | Nondirectional style | | |
|---|---|---|---|---|---|---|---|---|---|
| Proprotion with having the provision | All | Live | Defunct | All | Live | Defunct | All | Live | Defunct |
| High water mark | 55.8% | 75.3% | 30.1% | 53.5% | 74.8% | 28.3% | 61.5% | 76.5% | 35.4% |
| Leverage | 70.5% | 67.2% | 75.0% | 71.5% | 67.8% | 75.8% | 68.2% | 65.9% | 72.3% |
| Personal capital | 41.3% | 35.5% | 49.0% | 43.0% | 38.4% | 48.5% | 37.1% | 29.4% | 50.6% |
| Open public | 12.6% | 13.4% | 11.5% | 13.6% | 14.8% | 12.1% | 10.2% | 10.6% | 9.6% |
| Lockup period | 28.2% | 37.1% | 16.5% | 27.2% | 35.9% | 16.8% | 30.7% | 39.4% | 15.5% |
| Audit | 66.0% | 74.2% | 55.2% | 64.0% | 73.0% | 53.4% | 70.7% | 76.5% | 60.5% |

**Panel B: Sample of funds incepted before year 2000**

| | All funds | | | Directional style | | | Nondirectional style | | |
|---|---|---|---|---|---|---|---|---|---|
| Proprotion with having the provision | All | Live | Defunct | All | Live | Defunct | All | Live | Defunct |
| High water mark | 34.6% | 58.0% | 17.2% | 34.4% | 60.0% | 16.7% | 35.3% | 53.1% | 19.0% |
| Leverage | 72.8% | 69.7% | 75.0% | 73.6% | 69.8% | 76.3% | 70.4% | 69.6% | 71.1% |
| Personal capital | 51.3% | 46.9% | 54.6% | 52.1% | 49.8% | 53.8% | 49.1% | 40.2% | 57.3% |
| Open public | 11.5% | 11.3% | 11.6% | 12.6% | 13.3% | 12.2% | 8.4% | 6.7% | 10.0% |
| Lockup period | 18.7% | 30.0% | 10.4% | 17.9% | 29.3% | 9.9% | 21.2% | 31.4% | 11.8% |
| Audit | 71.1% | 88.5% | 58.2% | 68.7% | 87.4% | 55.9% | 77.8% | 91.2% | 65.4% |

**Panel C: Sample of funds incepted after year 2000**

| | All funds | | | Directional style | | | Nondirectional style | | |
|---|---|---|---|---|---|---|---|---|---|
| Proprotion with having the provision | All | Live | Defunct | All | Live | Defunct | All | Live | Defunct |
| High water mark | 88.8% | 90.0% | 84.2% | 86.6% | 88.4% | 80.5% | 92.9% | 92.8% | 93.3% |
| Leverage | 67.1% | 65.0% | 74.6% | 67.8% | 66.0% | 73.8% | 65.7% | 63.3% | 76.7% |
| Personal capital | 25.7% | 25.8% | 25.4% | 27.3% | 28.0% | 24.8% | 22.8% | 21.9% | 26.7% |
| Open public | 14.3% | 15.2% | 11.0% | 15.3% | 16.2% | 12.1% | 12.4% | 13.3% | 8.3% |
| Lockup period | 42.9% | 43.1% | 42.1% | 43.3% | 42.0% | 47.7% | 42.0% | 45.0% | 28.3% |
| Audit | 58.0% | 62.1% | 42.6% | 55.8% | 59.8% | 42.3% | 62.1% | 66.2% | 43.3% |

**Table 6:** Mean level of funds with each characteristic among fund groups.

**Panel A: Sample of all funds**

| | All funds | | | Directional style | | | Nondirectional style | | |
|---|---|---|---|---|---|---|---|---|---|
| Characteristic items | All | Live | defunct | All | Live | defunct | All | Live | defunct |
| Incentive fee (%) | 19.20 | 19.46 | 18.85 | 19.06 | 19.38 | 18.68 | 19.52 | 19.6 | 19.36 |
| Management fee (%) | 1.38 | 1.38 | 1.39 | 1.42 | 1.41 | 1.44 | 1.29 | 1.32 | 1.23 |
| Maximal leverage | 1.19 | 1.48 | 0.84 | 0.93 | 1.04 | 0.81 | 1.82 | 2.39 | 0.93 |
| Average leverage | 0.72 | 0.90 | 0.51 | 0.50 | 0.54 | 0.46 | 1.26 | 1.65 | 0.65 |
| Lockup period (month) | 3.24 | 4.29 | 1.86 | 3.11 | 4.12 | 1.92 | 3.56 | 4.64 | 1.66 |
| Redemptin period (month) | 2.45 | 2.52 | 2.36 | 2.28 | 2.38 | 2.16 | 2.85 | 2.80 | 2.95 |

**Panel B: Sample of funds incepted before year 2000**

| | All funds | | | Directional style | | | Nondirectional style | | |
|---|---|---|---|---|---|---|---|---|---|
| Characteristic items | All | Live | defunct | All | Live | defunct | All | Live | defunct |
| Incentive fee (%) | 18.89 | 19.24 | 18.63 | 18.77 | 19.16 | 18.50 | 19.24 | 19.4 | 19.05 |
| Management fee (%) | 1.39 | 1.38 | 1.41 | 1.45 | 1.43 | 1.47 | 1.23 | 1.26 | 1.21 |
| Maximal leverage | 1.10 | 1.53 | 0.80 | 0.91 | 1.05 | 0.82 | 1.63 | 2.63 | 0.74 |
| Average leverage | 0.67 | 0.94 | 0.47 | 0.50 | 0.56 | 0.46 | 1.14 | 1.84 | 0.51 |
| Lockup period (month) | 2.17 | 3.49 | 1.18 | 2.13 | 3.54 | 1.16 | 2.26 | 3.37 | 1.24 |
| Redemptin period (month) | 2.51 | 2.70 | 2.36 | 2.33 | 2.58 | 2.14 | 3.01 | 2.98 | 3.03 |

**Panel C: Sample of funds incepted after year 2000**

| | All funds | | | Directional style | | | Nondirectional style | | |
|---|---|---|---|---|---|---|---|---|---|
| Characteristic items | All | Live | defunct | All | Live | defunct | All | Live | defunct |
| Incentive fee (%) | 19.67 | 19.65 | 19.76 | 19.57 | 19.59 | 19.50 | 19.87 | 19.7 | 20.42 |
| Management fee (%) | 1.36 | 1.38 | 1.32 | 1.37 | 1.38 | 1.33 | 1.35 | 1.36 | 1.30 |
| Maximal leverage | 1.35 | 1.44 | 1.06 | 0.96 | 1.02 | 0.80 | 2.10 | 2.19 | 1.70 |
| Average leverage | 0.82 | 0.86 | 0.68 | 0.50 | 0.51 | 0.48 | 1.44 | 1.49 | 1.20 |
| Lockup period (month) | 4.91 | 4.97 | 4.70 | 4.81 | 4.66 | 5.33 | 5.11 | 5.53 | 3.15 |
| Redemptin period (month) | 2.36 | 2.36 | 2.36 | 2.20 | 2.19 | 2.24 | 2.67 | 2.68 | 2.66 |

Note: ”Incentive fee” is the percentage of fund profit. ”Incentive fee” is the percentage of asset under management. ”Maximal leverage” is the fund’s upper limit of external borrowing as a ratio of its own capital. ”Average leverage” is the fund’s external borrowing as a ratio of its own capital on average. ”Lockup period” is the number of months of unable redemption by investors during initial period ”Redemption Period” means the redemption frequency are provided by funds.

**Table 7 Test of the proportion and mean level of characteristics among fund groups**

Panel A: Comparison of defunct groups and live groups

| | Directional style | | | | | Nondirectional style | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Characteristic | Defunct | Live | Dif | t-value | | Defunct | Live | Dif | t-value | |
| Hwk | 0.28 | 0.75 | -0.46 | -22.06 | *** | 0.35 | 0.76 | -0.41 | -11.71 | *** |
| Leverage | 0.76 | 0.68 | 0.08 | 3.77 | *** | 0.72 | 0.66 | 0.06 | 1.82 | * |
| Pcapital | 0.48 | 0.38 | 0.10 | 4.27 | *** | 0.51 | 0.29 | 0.21 | 5.71 | *** |
| Lockup | 0.17 | 0.36 | -0.19 | -9.43 | *** | 0.16 | 0.39 | -0.24 | -7.59 | *** |
| Audit | 0.53 | 0.73 | -0.20 | -8.69 | *** | 0.61 | 0.76 | -0.16 | -4.49 | *** |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

| | Directional style | | | | | Nondirectional style | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Characteristic | Defunct | Live | Dif | t-value | | Defunct | Live | Dif | t-value | |
| Incentive fee (%) | 18.68 | 19.38 | -0.71 | -2.96 | *** | 19.36 | 19.62 | -0.26 | -0.68 | |
| Management fee (%) | 1.44 | 1.41 | 0.04 | 1.04 | | 1.23 | 1.32 | -0.09 | -2.46 | ** |
| Maximal leverage | 0.81 | 1.04 | -0.22 | -2.46 | ** | 0.93 | 2.39 | -1.47 | -4.92 | *** |
| Average leverage | 0.46 | 0.54 | -0.08 | -1.45 | | 0.65 | 1.65 | -1.01 | -4.69 | *** |
| Lockup period (month) | 1.92 | 4.12 | -2.20 | -8.81 | *** | 1.66 | 4.64 | -2.98 | -7.66 | *** |
| Redemptin period (month) | 2.16 | 2.38 | -0.22 | -1.92 | * | 2.95 | 2.80 | 0.14 | 0.64 | |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Panel B: Comparison of different inception periods

| | Directional style | | | | | Nondirectional style | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Characteristic | A | B | Dif | t-value | | A | B | Dif | t-value | |
| Hwk | 0.34 | 0.87 | -0.52 | -26.8 | *** | 0.35 | 0.93 | -0.58 | -20.87 | *** |
| Leverage | 0.74 | 0.68 | 0.06 | 2.58 | *** | 0.70 | 0.66 | 0.05 | 1.37 | |
| Pcapital | 0.52 | 0.27 | 0.25 | 10.82 | *** | 0.49 | 0.23 | 0.26 | 7.8 | *** |
| Lockup | 0.18 | 0.43 | -0.25 | -11.28 | *** | 0.21 | 0.42 | -0.21 | -6.16 | *** |
| Audit | 0.69 | 0.56 | 0.13 | 5.42 | *** | 0.78 | 0.62 | 0.16 | 4.66 | *** |

Note: 1.A represents the sample of funds incepted before year 2000. B represents the sample of funds incepted after year 2000
2. *** indicates statistical significance at the 1% level

| | Directional style | | | | | Non-directional style | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Characteristic | A | B | Dif | t-value | | A | B | Dif | t-value | |
| Incentive fee (%) | 18.77 | 19.57 | -0.81 | -3.78 | *** | 19.24 | 19.87 | -0.63 | -1.85 | * |
| Management fee (%) | 1.45 | 1.37 | 0.08 | 2.69 | *** | 1.23 | 1.35 | -0.12 | -3.63 | *** |
| Maximal leverage | 0.91 | 0.96 | -0.05 | -0.57 | | 1.63 | 2.10 | -0.46 | -1.41 | |
| Average leverage | 0.50 | 0.50 | -0.01 | -0.14 | | 1.14 | 1.44 | -0.30 | -1.25 | |
| Lockup period (month) | 2.13 | 4.81 | -2.68 | -9.79 | *** | 2.26 | 5.11 | -2.85 | -6.48 | *** |
| Redemptin period (month) | 2.33 | 2.20 | 0.13 | 1.21 | | 3.01 | 2.67 | 0.33 | 1.63 | |

Note: 1.A represents the sample of funds incepted before year 2000. B represents the sample of funds incepted after year 2000

2. *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Panel C: comparison of the directional fund groups and non-directional funds groups

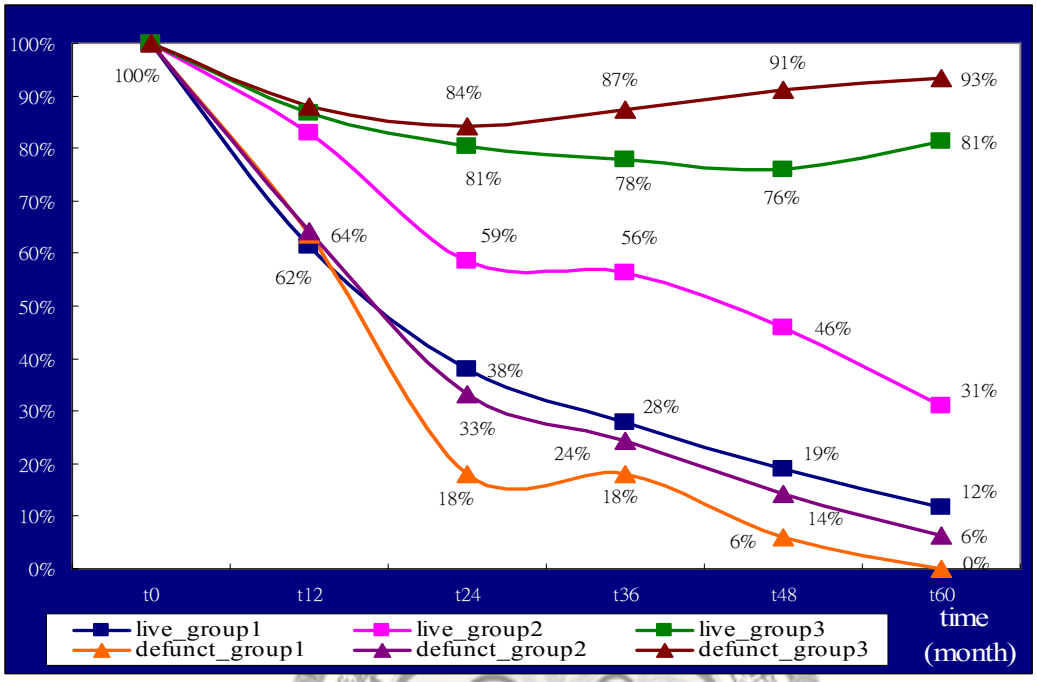
| Characteristic | Non-directional | Directional | Dif | t-value | |
|---|---|---|---|---|---|
| Hwk | 0.62 | 0.53 | 0.08 | 3.72 | *** |
| Leverage | 0.68 | 0.71 | -0.03 | -1.63 | |
| Pcapital | 0.37 | 0.43 | -0.06 | -2.74 | *** |
| Lockup | 0.31 | 0.27 | 0.04 | 1.8 | * |
| Audit | 0.71 | 0.64 | 0.07 | 3.29 | *** |

Note: *** indicates statistical significance at the 1% level, and * indicates statistical significance at the10% level

| Characteristic | Non-directional | Directional | Dif | t-value | |
|---|---|---|---|---|---|
| Incentive fee (%) | 19.52 | 19.06 | 0.46 | 2.21 | ** |
| Management fee (%) | 1.29 | 1.42 | -0.13 | -5.69 | *** |
| Maximal leverage | 1.82 | 0.93 | 0.89 | 4.9 | *** |
| Average leverage | 1.26 | 0.50 | 0.76 | 5.87 | *** |
| Lockup period (month) | 3.56 | 3.11 | 0.45 | 1.76 | * |
| Redemptin period (month) | 2.85 | 2.28 | 0.57 | 4.85 | *** |

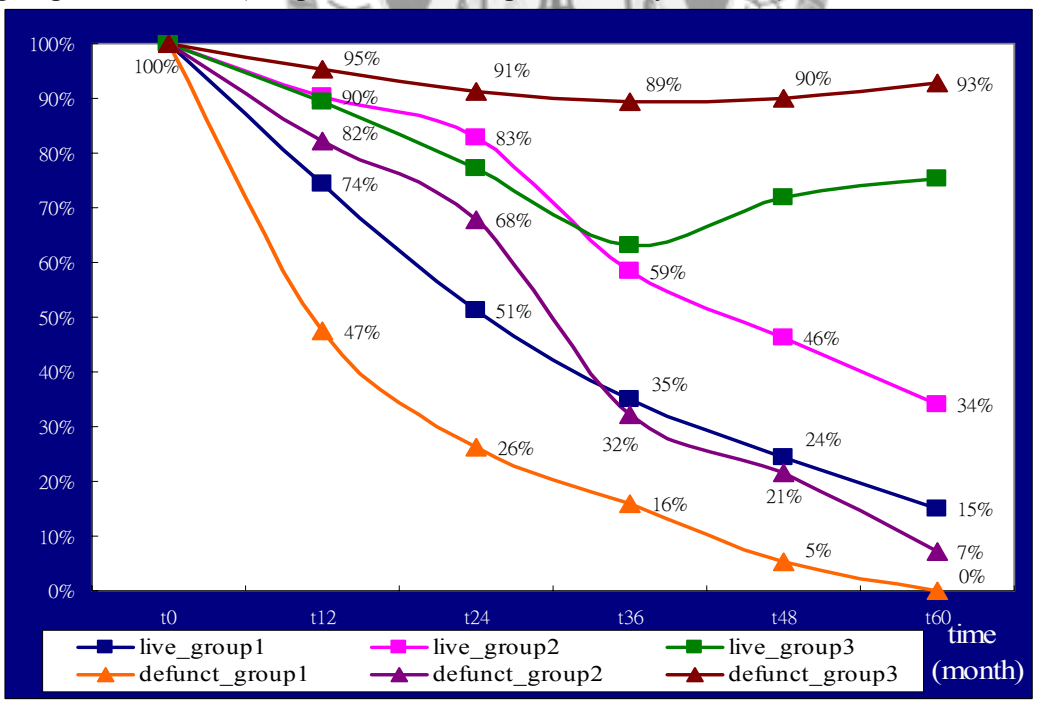
Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Figure 5 Trend of the proportion of AUM below the basic threshold of directional style group over time. (Sample of funds incepted before the year 2000)




Note: t0 represents initial time point, t12 represents the time of the 12 months after inception and so forth.

Figure 6 Trend of proportion of AUM below basic threshold of non-directional style groups over time (sample of funds incepted before year 2000)




Note: t0 represents initial time point, t12 represents the time of the 12 months after inception and so forth.

Table 8: Mean and median time of the funds which have achieved a basic and safe threshold in each group.

| | Directional style | | | | | | Nondirectional style | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| unit: months | Basic survival thrshold | | | Safe thrshold | | | Basic survival thrshold | | | Safe thrshold | | |
| Live funds | Group1 | Group2 | Group3 | Group1 | Group2 | Group3 | Group1 | Group2 | Group3 | Group1 | Group2 | Group3 |
| Median time | 15 | 28 | 18 | 44 | 34 | 27 | 25 | 38 | 22 | 45 | 66 | 25 |
| Mean time | 25 | 37 | 23 | 48 | 37 | 31 | 31 | 48 | 30 | 49 | 66 | 34 |
| Defunct funds | | | | | | | | | | | | |
| Median time | 14 | 16 | 13 | 27 | 40 | 21 | 10 | 31 | 25 | 23 | 38 | 39 |
| Mean time | 17 | 20 | 19 | 34 | 40 | 25 | 17 | 31 | 28 | 31 | 40 | 39 |

Table 9 Survival proportion and the performance of initially large sized funds which exceeded the basic threshold within two year
Panel A: Survival proportion of each different initial AUM group

| survival time | Example--total sample for directional style | | | | | | Directional style | | | | Nondirectional style | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No of observed | No. of survival | No. of induced live | Proportion of survival | No of adjusted observed | Adjusted proportion of survival | Total | Group_01 (Large) | Group_02 (small) | difference | Total | Group_01 (Large) | Group_02 (small) | difference |
| above 24 months | 1126 | 1018 | 3 | 90.67% | | 90.67% | 90.67% | 97.71% | 89.38% | 8.33% | 91.36% | 95.83% | 91.08% | 4.76% |
| above 36 months | 1126 | 876 | 9 | 78.60% | | 78.60% | 78.60% | 89.14% | 76.66% | 12.49% | 83.46% | 95.83% | 82.68% | 13.16% |
| above 48 months | 1126 | 761 | 14 | 68.83% | | 68.83% | 68.83% | 84.00% | 66.04% | 17.96% | 76.54% | 87.50% | 75.85% | 11.65% |
| above 60 months | 1126 | 649 | 22 | 59.59% | 7 | 59.96% | 59.96% | 77.71% | 56.67% | 21.04% | 67.33% | 66.67% | 67.37% | -0.71% |
| above 72 months | 1126 | 467 | 26 | 43.78% | 112 | 48.62% | 48.62% | 65.82% | 45.44% | 20.38% | 56.58% | 57.14% | 56.55% | 0.60% |
| above 84 months | 1126 | 344 | 29 | 33.13% | 179 | 39.39% | 39.39% | 57.64% | 36.11% | 21.52% | 46.86% | 35.29% | 47.51% | -12.21% |

Note: (1).No. of induced live indicates the numbers of defunct funds that have positive buy and hold returns prior to the last 6 and 12 months and last AUMs exceeding the basic threshold, exclusive of liquidated funds (2).No of adjusted observed indicates the numbers of observed live funds that their ages are smaller than observed survival time (3). The fund is classified to group0_1 if the initial AUM exceeds the basic threshold, else to group0_2.

Panel B: Conditional survival proportion (Conditional: exceeds the basic threshold within two year)

| surival time | example--initial small funds for directional style Conditional : AUM at the end of the second year had exceeded basic threshold | | | | | | Directional style | | | Nondirectional style | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No of exceeding threshold within 2 year | No. of survival | No. of induced live | Proportion of survival | No of adjusted observed | Adjusted proportion of survival | Exceed shreshold | No exceed shreshold | difference | Exceed shreshold | No exceed shreshold | difference |
| above 36 months* | 309 | 289 | 3 | 94.50% | | 94.50% | 94.50% | 80.71% | 13.79% | 95.88% | 88.40% | 7.48% |
| above 48 months* | 309 | 254 | 6 | 84.14% | | 84.14% | 84.14% | 67.90% | 16.24% | 90.72% | 80.00% | 10.72% |
| above 60 months* | 309 | 214 | 11 | 72.82% | 2 | 73.29% | 73.29% | 57.17% | 16.12% | 84.38% | 69.23% | 15.14% |
| above 72 months* | 309 | 149 | 13 | 52.43% | 43 | 60.90% | 60.90% | 44.76% | 16.14% | 74.39% | 56.82% | 17.57% |
| above 84 months* | 309 | 109 | 14 | 39.81% | 69 | 51.25% | 51.25% | 34.04% | 17.21% | 67.61% | 44.90% | 22.71% |

Note: (1). Above 36 months* indicates that the funds have been incepted 24 months and at least will survive 12 month in future, above 48 months* indicates that the funds have been incepted 24 months and at least will survive 24 month in future and so forth.

Panel C: Comparison between the performance of initially large sized funds and those of initially small sized funds which exceeded the basic threshold within two years

| | Directional style (mean return ) | | | | Non-directional style (mean return) | | | |
|---|---|---|---|---|---|---|---|---|
| | 12-month buy and hold return % | | 12- month active return % | | 12-month buy and hold return % | | 12- month active return % | |
| Year | Group_01 (Large) | exceeding threshold within 2 year | Group_01 (Large) | exceeding threshold within 2 year | Group_01 (Large) | exceeding threshold within 2 year | Group_01 (Large) | exceeding threshold within 2 year |
| The first year | 12.38 | 29.27 | 29.91 | 84.42 | 11.07 | 16.70 | 11.47 | 16.55 |
| The second year | 16.93 | 13.55 | 26.23 | 28.01 | 9.29 | 8.13 | 12.10 | 12.86 |
| The third year | 9.20 | 7.48 | 30.54 | 29.57 | 5.71 | 9.36 | 14.51 | 14.10 |
| The fouth year | 2.52 | 6.01 | 20.50 | 25.79 | 6.98 | 5.60 | 15.31 | 13.21 |
| The fifth year | 5.27 | 7.17 | 21.65 | 29.60 | 4.22 | 5.57 | 11.35 | 14.37 |
| The sixth year | 2.98 | 5.21 | 22.46 | 23.35 | -0.63 | 6.34 | 9.04 | 13.52 |

Note: (1). 12-month active return is defined as 12-month buy and hold return of the fund subtract that of the corresponding CS/Tremont style benchmark

Table 10. Mean of the flow and FAV for each defunct funds group over the whole duration of the period and the last 3,6 and 12 months before exit

| Directional funds | | | FAV(Quarter) | | FAV(Semiannual) | | FLOW(Quarter) | | FLOW(Semiannual) | | FLOW(Annual) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | Asset Group | Sample size | Last 3 months | Mean of all months | Last 6 months | Mean of all months | Last 3 months | Mean of all months | Last 6 months | Mean of all months | Last 12 months | Mean of all months |
| Inception date before 2000 | Group1 | 66 | -9% | 16% | -7% | 17% | -5% | 17% | -1% | 41% | 23% | 114% |
| | Group2 | 100 | 1% | 13% | 1% | 14% | -5% | 26% | -2% | 59% | 36% | 173% |
| | Group3 | 500 | 6% | 9% | 6% | 9% | -4% | 12% | -6% | 30% | -5% | 68% |
| | All | 666 | 3% | 11% | 4% | 11% | -4% | 15% | -5% | 36% | 4% | 88% |

| Nondirectional funds | | | FAV(Quarter) | | FAV(Semiannual) | | FLOW(Quarter) | | FLOW(Semiannual) | | FLOW(Annual) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | Asset Group | Sample size | Last 3 months | Mean of all months | Last 6 months | Mean of all months | Last 3 months | Mean of all months | Last 6 months | Mean of all months | Last 12 months | Mean of all months |
| Inception date before 2000 | Group1 | 23 | 6% | 8% | 7% | 9% | -2% | 18% | 0% | 43% | 11% | 121% |
| | Group2 | 33 | -6% | 7% | 8% | 7% | 2% | 20% | 4% | 40% | 10% | 135% |
| | Group3 | 155 | 5% | 8% | 8% | 9% | -13% | 14% | -5% | 40% | 19% | 106% |
| | All | 211 | 3% | 8% | 8% | 9% | -9% | 15% | -3% | 40% | 17% | 113% |

Table 11. Test of difference between defunct funds and live funds in the worst degree of the quarter (semiannual) flow and Quarter (Semiannual) FAV

| Directional funds | | DIF(FAV_Quarter) | | | | | | DIF(FAV_Semiannul) | | | | | | DIF(Flow_Quarter) | | | | | | DIF(Flow_Semiannual) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | Asset Group | Defunct | Live | Dif | T value | P_value | | Defunct | Live | Dif | T value | P_value | | Defunct | Live | Dif | T value | P_value | | Defunct | Live | Dif | T value | P_value | |
| Inception date before 2000 | Group1 | -0.28 | -0.02 | -0.26 | -4.03 | 0.00 | *** | -0.24 | -0.01 | -0.22 | -3.63 | 0.00 | *** | -0.22 | 0.01 | -0.22 | -0.07 | 0.94 | | -0.42 | 0.09 | -0.51 | -0.15 | 0.88 | |
| | Group2 | -0.08 | -0.02 | -0.06 | -1.25 | 0.22 | | -0.10 | -0.02 | -0.07 | -1.56 | 0.12 | | -0.26 | -0.26 | 0.00 | -0.06 | 0.95 | | -0.51 | -1.57 | 1.06 | 2.73 | 0.01 | *** |
| | Group3 | -0.04 | -0.03 | -0.01 | -0.20 | 0.84 | | -0.04 | -0.04 | -0.01 | -0.28 | 0.78 | | -0.20 | -0.15 | -0.05 | -1.08 | 0.28 | | -0.45 | -0.30 | -0.15 | -2.02 | 0.05 | ** |
| | All | -0.06 | -0.02 | -0.03 | -1.30 | 0.20 | | -0.06 | -0.03 | -0.03 | -1.20 | 0.23 | | -0.21 | -0.28 | 0.07 | 0.06 | 0.95 | | -0.46 | -0.54 | 0.08 | 0.06 | 0.95 | |

| Nondirectional funds | | DIF(FAV_Quarter) | | | | | | DIF(FAV_Semiannul) | | | | | | DIF(Flow_Quarter) | | | | | | DIF(Flow_Semiannual) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | Asset Group | Defunct | Live | Dif | T value | P_value | | Defunct | Live | Dif | T value | P_value | | Defunct | Live | Dif | T value | P_value | | Defunct | Live | Dif | T value | P_value | |
| Inception date before 2000 | Group1 | -0.04 | 0.00 | -0.04 | -0.80 | 0.433 | | -0.04 | 0.01 | -0.05 | -1.33 | 0.20 | | -0.22 | 1.36 | -1.58 | -1.64 | 0.10 | | -0.48 | 2.81 | -3.29 | -2.43 | 0.02 | ** |
| | Group2 | -0.13 | -0.01 | -0.12 | -1.73 | 0.096 | * | 0.01 | 0.00 | 0.01 | 0.57 | 0.57 | | -0.16 | -0.17 | 0.00 | 0.05 | 0.96 | | -0.32 | -0.38 | 0.06 | 0.41 | 0.69 | |
| | Group3 | -0.05 | -0.02 | -0.03 | -0.82 | 0.412 | | 0.01 | -0.01 | 0.01 | 0.71 | 0.48 | | -0.29 | -0.13 | -0.17 | -3.25 | 0.00 | *** | -0.48 | -0.31 | -0.17 | -3.25 | 0.00 | *** |
| | All | -0.06 | -0.01 | -0.05 | -1.89 | 0.063 | * | 0.00 | 0.00 | 0.00 | -0.20 | 0.84 | | -0.26 | 0.55 | -0.81 | -1.83 | 0.07 | * | -0.45 | 1.11 | -1.56 | -2.51 | 0.01 | ** |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Table12. Summary statistics of the performance and risk for each group from January 1994 to November 2004.
Panel A: Summary statistics of the monthly return

| | | | Absoulate monthly return | | | | | | | | Relative monthly return | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sample size | Average return | | Standard deviation | | Skewness | | Kurtosis | | Average return | | Standard deviation | | Skewness | | Kurtosis | |
| Directional style | Group | | Mean | Median | Mean | Median | Mean | Median | Mean | Median | Mean | Median | Mean | Median | Mean | Median | Mean | Median |
| Live funds | group 1 | 232 | 1.426 | 1.263 | 4.848 | 4.128 | 0.314 | 0.366 | 4.711 | 2.608 | 0.507 | 0.318 | 4.633 | 3.908 | 0.304 | 0.209 | 2.919 | 2.045 |
| | group 2 | 107 | 1.214 | 1.107 | 5.615 | 4.936 | 0.504 | 0.320 | 3.259 | 1.984 | 0.304 | 0.152 | 5.195 | 4.534 | 0.383 | 0.239 | 3.285 | 1.958 |
| | group 3 | 121 | 1.029 | 0.932 | 6.567 | 6.140 | 0.444 | 0.306 | 3.339 | 1.737 | 0.215 | 0.128 | 6.091 | 5.367 | 0.399 | 0.288 | 3.283 | 1.916 |
| Defunct funds | group 1 | 66 | 1.512 | 1.257 | 5.670 | 5.030 | 0.107 | 0.379 | 3.047 | 1.306 | 0.488 | 0.395 | 5.268 | 4.551 | 0.322 | 0.257 | 2.151 | 1.221 |
| | group 2 | 100 | 1.296 | 1.112 | 6.272 | 5.544 | -0.057 | 0.276 | 4.250 | 2.126 | 0.310 | 0.262 | 5.890 | 4.856 | 0.189 | 0.176 | 2.726 | 1.562 |
| | group 3 | 500 | 0.510 | 0.647 | 7.035 | 5.693 | 0.007 | 0.035 | 2.792 | 1.464 | -0.425 | -0.278 | 6.904 | 5.553 | 0.097 | 0.070 | 2.146 | 1.046 |
| Nondirectional style | | | | | | | | | | | | | | | | | | |
| Live funds | group 1 | 93 | 0.988 | 0.919 | 1.805 | 1.523 | -0.659 | -0.101 | 8.898 | 2.366 | 0.196 | 0.093 | 1.779 | 1.574 | 0.239 | 0.631 | 9.719 | 5.392 |
| | group 2 | 42 | 0.969 | 0.829 | 2.591 | 1.598 | -0.139 | -0.188 | 4.428 | 3.289 | 0.142 | 0.019 | 2.577 | 1.675 | 0.599 | 0.463 | 4.712 | 3.836 |
| | group 3 | 59 | 0.813 | 0.743 | 2.467 | 2.015 | 0.131 | 0.087 | 4.568 | 2.106 | -0.023 | -0.058 | 2.480 | 1.854 | 0.614 | 0.321 | 4.444 | 2.957 |
| Defunct funds | group 1 | 23 | 1.136 | 1.033 | 2.557 | 2.423 | -1.122 | -0.988 | 9.700 | 6.191 | 0.304 | 0.279 | 2.515 | 1.883 | -0.112 | 0.416 | 8.291 | 4.088 |
| | group 2 | 33 | 1.043 | 0.855 | 2.710 | 2.018 | -1.413 | -0.516 | 10.038 | 3.468 | 0.294 | 0.075 | 2.833 | 2.297 | -0.236 | 0.102 | 9.594 | 5.905 |
| | group 3 | 155 | 0.449 | 0.470 | 3.786 | 2.913 | -0.470 | -0.294 | 4.818 | 2.313 | -0.434 | -0.455 | 3.671 | 2.858 | 0.085 | 0.109 | 4.041 | 1.521 |

Panel B: Distribution of the autocorrelation of each group

| Directional style | period | The proportion of the first k autocorrelations significantly | | | | Mean of the kth autocorrelation coefficient | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $\rho_1$ | | $\rho_3$ | | $\rho_6$ | | $\rho_{12}$ | |
| | | 1 | 3 | 6 | 12 | All | Sig* | All | Sig* | All | Sig* | All | Sig* |
| Live funds | group 1 | 47% | 47% | 45% | 41% | 0.15 | 0.26 | 0.04 | 0.09 | 0.03 | 0.05 | -0.03 | -0.03 |
| | group 2 | 33% | 36% | 35% | 34% | 0.13 | 0.25 | 0.00 | 0.03 | 0.05 | 0.08 | -0.03 | -0.03 |
| | group 3 | 32% | 27% | 31% | 31% | 0.10 | 0.23 | 0.01 | 0.06 | 0.02 | 0.04 | -0.03 | -0.04 |
| Defunct funds | group 1 | 30% | 20% | 24% | 14% | 0.14 | 0.28 | 0.02 | 0.09 | 0.06 | 0.11 | -0.05 | -0.04 |
| | group 2 | 31% | 29% | 23% | 14% | 0.08 | 0.18 | 0.00 | 0.09 | 0.03 | 0.07 | -0.05 | -0.09 |
| | group 3 | 19% | 19% | 19% | 17% | 0.05 | 0.15 | -0.01 | 0.03 | 0.01 | 0.04 | -0.03 | -0.03 |
| Nondirectional style | | | | | | | | | | | | | |
| Live funds | group 1 | 83% | 76% | 75% | 67% | 0.27 | 0.32 | 0.11 | 0.15 | 0.02 | 0.04 | 0.03 | 0.05 |
| | group 2 | 69% | 71% | 60% | 48% | 0.22 | 0.28 | 0.07 | 0.09 | -0.01 | -0.01 | 0.02 | 0.05 |
| | group 3 | 59% | 63% | 56% | 64% | 0.21 | 0.33 | 0.13 | 0.19 | 0.08 | 0.12 | 0.05 | 0.06 |
| Defunct funds | group 1 | 57% | 52% | 57% | 57% | 0.26 | 0.42 | 0.14 | 0.24 | 0.03 | 0.08 | 0.05 | 0.10 |
| | group 2 | 45% | 42% | 39% | 36% | 0.18 | 0.33 | 0.09 | 0.20 | 0.03 | 0.13 | 0.03 | 0.07 |
| | group 3 | 34% | 31% | 34% | 30% | 0.16 | 0.37 | 0.01 | 0.10 | 0.01 | 0.05 | 0.00 | 0.01 |

Note: 1.the proportion reflects that the ratio of numbers of funds with the p-value of the Ljung-Box Q-statistic below 10% to sample size
2.Sig* means that mean of all significant coefficients of autocorrelation at the 1% level

Panel C: Summary of the various measures of performance and risk

| | | Performance | | | | | | | | Risk | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sharpe Ratio | | Information Ratio | | Jensen's alpha (Alpha1) | | | | β | | | | Maximal loss (monthly) | | Maximal loss respect with market | | Maximal drawdown | | Average drawdown | |
| Style | Group | Mean | Std | Mean | Std | Mean | Median | Significant Proportion | | Mean | Median | Significant Proportion | | Mean | Median | Mean | Median | Mean | Median | Mean | Median |
| | | | | | | | | Positive | Negative | | | Positive | Negative | | | | | | | | |
| Directional style | | | | | | | | | | | | | | | | | | | | | |
| Live funds | group 1 | 0.30 | 0.28 | 0.09 | 0.12 | 0.75 | 0.629 | 52.59% | 0.00% | 0.647 | 0.569 | 84.48% | 3.45% | -13.42 | -10.15 | -2.31 | -0.37 | -14.91 | -11.97 | -5.28 | -4.39 |
| | group 2 | 0.18 | 0.13 | 0.04 | 0.12 | 0.47 | 0.383 | 29.91% | 1.87% | 0.776 | 0.692 | 81.31% | 1.87% | -13.88 | -12.68 | -2.81 | -2.44 | -18.11 | -15.87 | -7.75 | -6.52 |
| | group 3 | 0.14 | 0.13 | 0.03 | 0.11 | 0.36 | 0.332 | 23.14% | 2.48% | 0.803 | 0.731 | 79.34% | 4.13% | -18.00 | -14.74 | -7.41 | -5.50 | -20.32 | -17.95 | -8.80 | -7.01 |
| Defunct funds | group 1 | 0.21 | 0.20 | 0.07 | 0.20 | 0.64 | 0.485 | 28.79% | 3.03% | 0.747 | 0.606 | 84.85% | 1.52% | -12.34 | -10.08 | -1.91 | -0.12 | -16.00 | -11.87 | -6.89 | -5.47 |
| | group 2 | 0.16 | 0.25 | 0.04 | 0.18 | 0.42 | 0.330 | 16.00% | 3.00% | 0.741 | 0.671 | 73.00% | 1.00% | -15.90 | -12.42 | -5.16 | -2.39 | -16.54 | -13.74 | -7.20 | -5.81 |
| | group 3 | 0.03 | 0.22 | -0.07 | 0.21 | -0.37 | -0.117 | 7.60% | 11.20% | 0.711 | 0.483 | 61.20% | 2.80% | -16.99 | -13.37 | -6.85 | -3.64 | -19.42 | -14.56 | -9.13 | -6.86 |
| Nondirectional style | | | | | | | | | | | | | | | | | | | | | |
| Live funds | group 1 | 0.50 | 0.34 | 0.07 | 0.21 | 0.39 | 0.360 | 67.74% | 0.00% | 0.673 | 0.476 | 88.17% | 0.00% | -6.60 | -3.82 | -0.52 | 1.12 | -7.89 | -4.90 | -2.38 | -1.94 |
| | group 2 | 0.43 | 0.63 | 0.02 | 0.20 | 0.27 | 0.254 | 42.86% | 0.00% | 0.711 | 0.467 | 83.33% | 0.00% | -7.86 | -4.07 | -1.76 | -0.63 | -11.02 | -5.81 | -3.25 | -1.94 |
| | group 3 | 0.30 | 0.24 | -0.03 | 0.17 | 0.24 | 0.180 | 38.98% | 3.39% | 0.534 | 0.461 | 64.41% | 1.69% | -6.59 | -5.56 | -1.56 | 0.32 | -7.76 | -6.14 | -2.95 | -2.40 |
| Defunct funds | group 1 | 0.40 | 0.35 | 0.13 | 0.30 | 0.34 | 0.397 | 56.52% | 8.70% | 0.897 | 0.416 | 73.91% | 0.00% | -10.44 | -6.40 | -3.97 | -0.77 | -11.88 | -6.46 | -5.18 | -2.24 |
| | group 2 | 0.28 | 0.42 | 0.06 | 0.29 | 0.46 | 0.344 | 42.42% | 15.15% | 0.557 | 0.261 | 63.64% | 3.03% | -9.23 | -6.20 | -3.71 | -3.79 | -11.06 | -7.21 | -4.79 | -3.32 |
| | group 3 | 0.06 | 0.28 | -0.15 | 0.27 | -0.19 | -0.055 | 12.26% | 21.94% | 0.626 | 0.476 | 50.32% | 3.23% | -10.18 | -7.62 | -5.33 | -4.13 | -13.26 | -9.39 | -6.42 | -3.67 |

Note: Sharpe ratio calculated using the average 90 day T-bill rate.

Table 13 Performance of defunct funds over all of the duration and the last 12 months before exit
Panel A Mean returns of defunct funds over the last 3, 6 and 12months before exit

| Style | Asset Group | Sample size | Absolute Return (annual) | | | Excess Return (annual) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Last 3 months | Last 6 months | Last 12 months | Last 3 months | Last 6 months | Last 12 months |
| Directional style | Group1 | 66 | 2.89 | 1.53 | 2.52 | -4.63 | -5.09 | -1.97 |
| | Group2 | 100 | -7.50 | -4.46 | -3.24 | -16.22 | -11.42 | -10.28 |
| | Group3 | 500 | -17.06 | -15.17 | -8.78 | -25.82 | -24.22 | -17.36 |
| Nondirectional style | Group1 | 23 | -6.46 | -4.64 | 1.25 | -10.83 | -9.44 | -4.27 |
| | Group2 | 33 | -17.19 | -2.35 | 1.82 | -22.23 | -8.94 | -5.41 |
| | Group3 | 155 | -8.77 | -5.68 | -3.01 | -17.78 | -15.45 | -12.74 |

Panel B: Information of the difference between defunct funds over all of the duration and the last 12 months before exit

| Style | Asset Group | Sample size | Absolute Return (annual) | | | | | | | Excess Return (annual) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Last 12 months | Mean of all months | difference | | Proportion | | | Last 12 months | Mean of all months | difference | | Proportion | | |
| | | | | | Mean | Median | Negative difference | A | B | | | Mean | Median | Negative difference | A | B |
| Directional style | Group1 | 66 | 2.52 | 18.14 | -15.62 | -8.91 | 79% | 38% | 39% | -1.97 | 5.86 | -7.82 | -6.12 | 62% | 58% | 30% |
| | Group2 | 100 | -3.24 | 15.55 | -18.80 | -12.60 | 76% | 44% | 47% | -10.28 | 3.72 | -14.00 | -8.88 | 68% | 67% | 49% |
| | Group3 | 500 | -8.78 | 6.13 | -14.91 | -8.66 | 74% | 57% | 44% | -17.36 | -5.10 | -12.42 | -8.47 | 69% | 72% | 44% |
| Nondirectional style | Group1 | 23 | 1.25 | 13.63 | -12.38 | -11.44 | 78% | 43% | 52% | -4.27 | 3.65 | -7.92 | -7.44 | 74% | 65% | 48% |
| | Group2 | 33 | 1.82 | 12.52 | -10.69 | -9.26 | 88% | 52% | 48% | -5.41 | 3.53 | -8.94 | -8.82 | 82% | 67% | 48% |
| | Group3 | 155 | -3.01 | 5.39 | -8.39 | -5.99 | 76% | 52% | 49% | -12.74 | -5.21 | -7.53 | -4.88 | 70% | 85% | 50% |

Note: A represent the condition of a negative mean return over the last 12 months and a lower than average return; B represents the condition of the standard deviation of the last 12 months above the standard deviation

Table 14 Test of the difference between the worst degree of the performance of defunct funds and live funds over the last m periods. Overlap

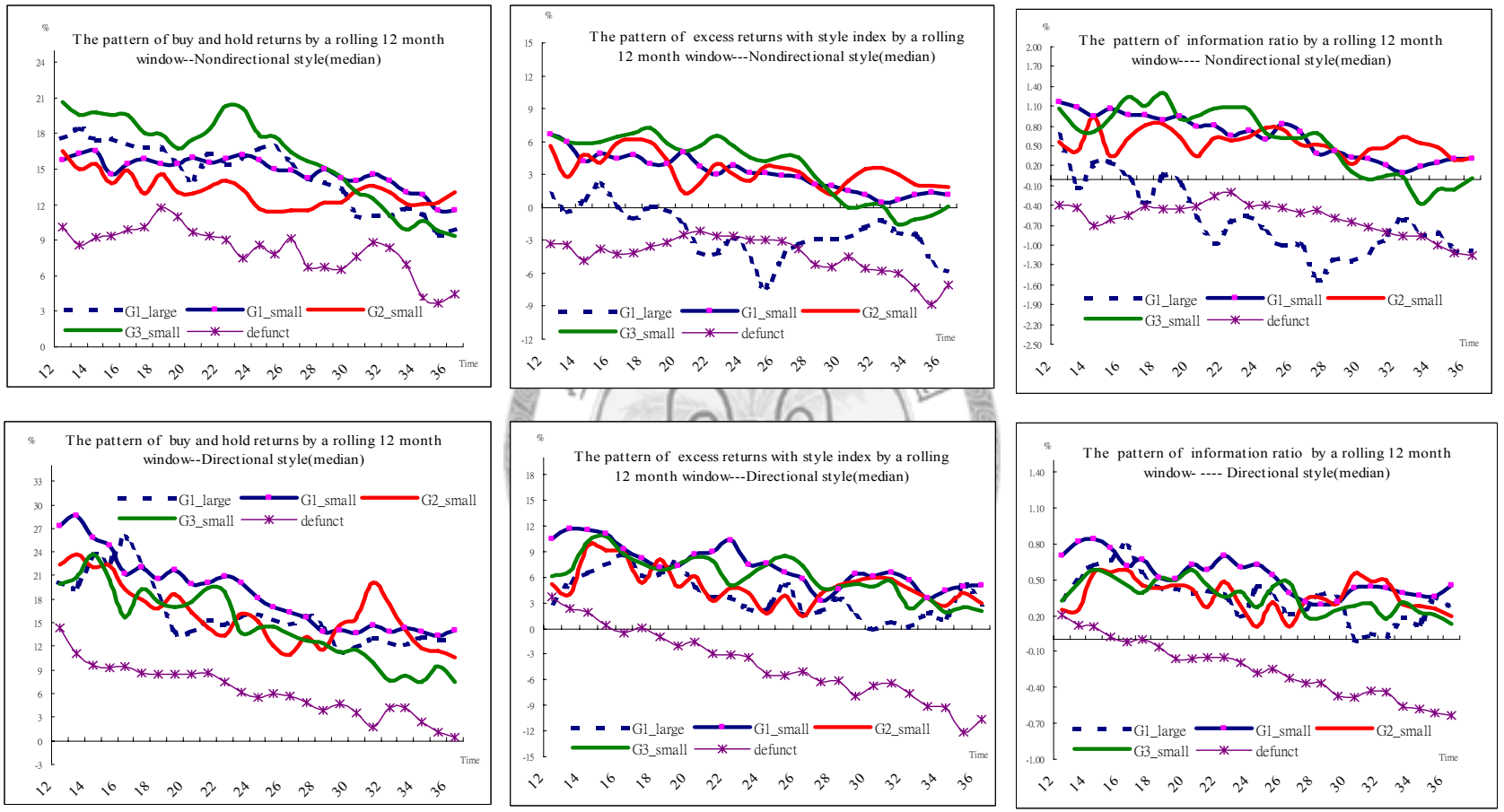
| | | Difference in the worse degree of performance between defunct funds and live funds over last M months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Absolute performance (Absolute return) | | | | | | Relative performance (Excess return) | | | | | |
| type | Asset Group | Defunct | Live | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| Directional type M=12 | Group1 | -1.11 | -0.17 | -0.94 | -3.82 | 0.00 | *** | -0.58 | -0.19 | -0.40 | -1.98 | 0.05 | * |
| | Group2 | -1.17 | -0.29 | -0.88 | -3.56 | 0.00 | *** | -1.00 | -0.20 | -0.80 | -3.73 | 0.00 | *** |
| | Group3 | -0.93 | -0.30 | -0.63 | -5.32 | <.0001 | *** | -0.88 | -0.26 | -0.62 | -6.36 | <.0001 | *** |
| | All | -0.98 | -0.25 | -0.73 | -6.41 | <.0001 | *** | -0.91 | -0.22 | -0.69 | -7.82 | <.0001 | *** |
| Directional type M=6 | Group1 | -1.22 | -0.23 | -0.98 | -2.32 | 0.02 | ** | -0.91 | -0.23 | -0.68 | -1.92 | 0.06 | * |
| | Group2 | -1.55 | -0.40 | -1.15 | -3.20 | 0.00 | *** | -1.34 | -0.26 | -1.08 | -3.54 | 0.00 | *** |
| | Group3 | -1.50 | -0.40 | -1.10 | -4.91 | <.0001 | *** | -1.43 | -0.32 | -1.11 | -5.92 | <.0001 | *** |
| | All | -1.53 | -0.35 | -1.18 | -5.44 | <.0001 | *** | -1.44 | -0.27 | -1.17 | -6.42 | <.0001 | *** |
| Nondirectional type M=12 | Group1 | -0.84 | -0.16 | -0.682 | -3.43 | 0.0023 | *** | -0.47 | -0.14 | -0.328 | -1.72 | 0.0989 | * |
| | Group2 | -0.74 | -0.2 | -0.545 | -3.63 | 0.001 | *** | -0.67 | -0.12 | -0.555 | -3.59 | 0.0012 | *** |
| | Group3 | -0.67 | -0.24 | -0.437 | -4.1 | <.0001 | *** | -0.63 | -0.21 | -0.423 | -4.18 | <.0001 | *** |
| | All | -0.74 | -0.2 | -0.54 | -5.59 | <.0001 | *** | -0.65 | -0.17 | -0.487 | -5.5 | <.0001 | *** |
| Nondirectional type M=6 | Group1 | -1.38 | -0.19 | -1.19 | -2.80 | 0.01 | ** | -0.96 | -0.17 | -0.79 | -2.09 | 0.05 | ** |
| | Group2 | -0.92 | -0.22 | -0.70 | -2.61 | 0.01 | ** | -0.82 | -0.14 | -0.69 | -2.54 | 0.02 | ** |
| | Group3 | -0.99 | -0.28 | -0.71 | -3.99 | 0.00 | *** | -0.94 | -0.23 | -0.71 | -3.96 | 0.00 | *** |
| | All | -1.11 | -0.24 | -0.88 | -5.39 | <.0001 | *** | -1.00 | -0.19 | -0.81 | -5.40 | <.0001 | *** |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

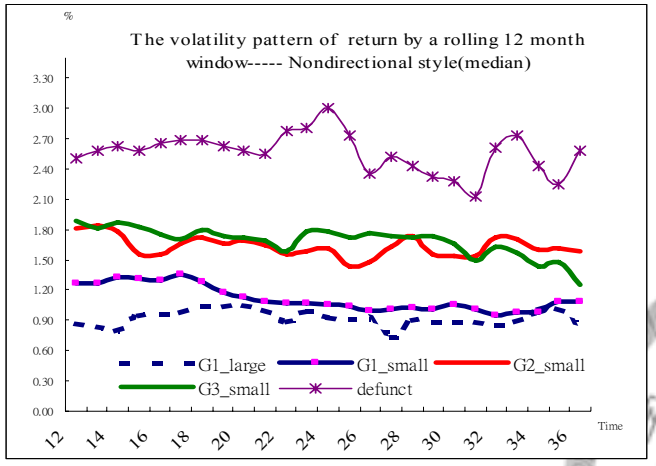
| | | Difference in the worse degree of performance between defunct funds and live funds over last M months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Absolute performance (Annual return) | | | | | | Relative performance (Excess annual return) | | | | | |
| type | Asset Group | Defunct | Live | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| Directional type M=12 | Group1 | -13.33 | -2.05 | -11.28 | -3.81 | 0.00 | *** | -7.00 | -2.24 | -4.75 | -1.88 | 0.07 | * |
| | Group2 | -14.06 | -3.52 | -10.55 | -3.25 | 0.00 | *** | -12.02 | -2.45 | -9.58 | -3.22 | 0.00 | *** |
| | Group3 | -11.16 | -3.55 | -7.61 | -4.38 | <.0001 | *** | -10.56 | -3.11 | -7.44 | -5.33 | <.0001 | *** |
| | All | -11.80 | -3.05 | -8.75 | -5.52 | <.0001 | *** | -10.87 | -2.60 | -8.27 | -6.75 | <.0001 | *** |
| Directional type M=6 | Group1 | -14.58 | -2.77 | -11.80 | -2.23 | 0.03 | ** | -10.90 | -2.75 | -8.15 | -1.85 | 0.07 | * |
| | Group2 | -18.58 | -4.78 | -13.80 | -3.03 | 0.00 | *** | -16.08 | -3.12 | -12.96 | -3.26 | 0.00 | *** |
| | Group3 | -18.00 | -4.85 | -13.15 | -4.31 | <.0001 | *** | -17.12 | -3.86 | -13.26 | -5.35 | <.0001 | *** |
| | All | -18.36 | -4.19 | -14.17 | -4.84 | <.0001 | *** | -17.28 | -3.26 | -14.02 | -5.86 | <.0001 | *** |
| Nondirectional type M=12 | Group1 | -10.12 | -1.93 | -8.18 | -3.21 | 0.00 | *** | -5.66 | -1.73 | -3.94 | -1.73 | 0.10 | |
| | Group2 | -8.87 | -2.34 | -6.54 | -3.88 | 0.00 | *** | -8.06 | -1.40 | -6.66 | -3.58 | 0.00 | *** |
| | Group3 | -8.09 | -2.84 | -5.24 | -3.69 | 0.00 | *** | -7.58 | -2.51 | -5.08 | -3.74 | 0.00 | *** |
| | All | -8.86 | -2.38 | -6.48 | -5.48 | <.0001 | *** | -7.85 | -2.00 | -5.84 | -5.40 | <.0001 | *** |
| Nondirectional type M=6 | Group1 | -16.58 | -2.32 | -14.27 | -2.71 | 0.01 | ** | -11.51 | -1.98 | -9.53 | -1.99 | 0.06 | * |
| | Group2 | -11.04 | -2.69 | -8.36 | -2.93 | 0.01 | *** | -9.89 | -1.67 | -8.22 | -2.75 | 0.01 | ** |
| | Group3 | -11.87 | -3.38 | -8.48 | -3.34 | 0.00 | *** | -11.30 | -2.81 | -8.50 | -3.28 | 0.00 | *** |
| | All | -13.36 | -2.87 | -10.50 | -5.43 | <.0001 | *** | -12.05 | -2.29 | -9.76 | -5.43 | <.0001 | *** |

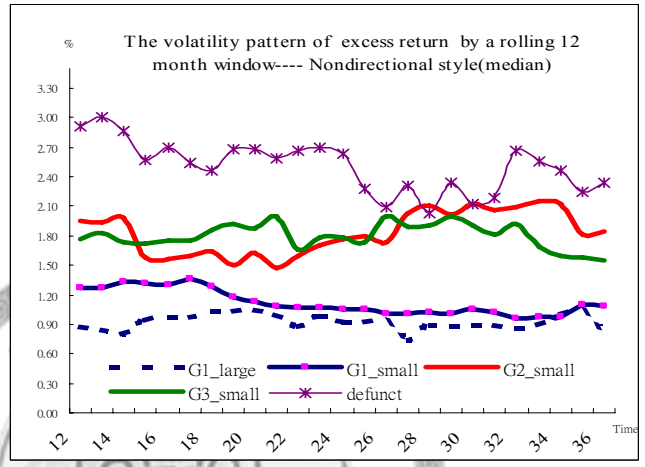
Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

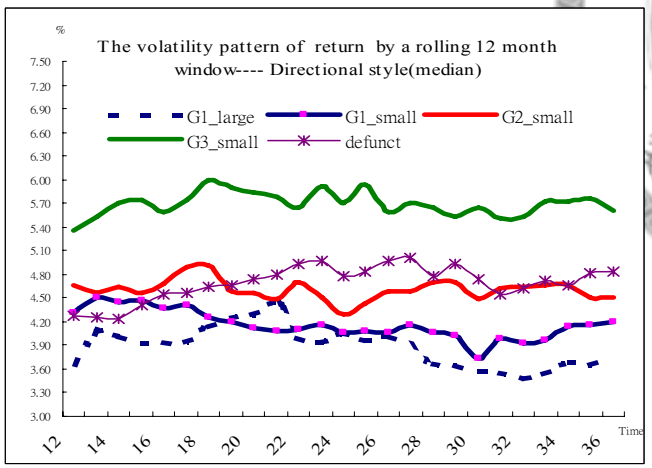
Figure 7 Trend of the performance and volatility of each group over the first three years from inception.
Panel A. performance



Panel B volatility



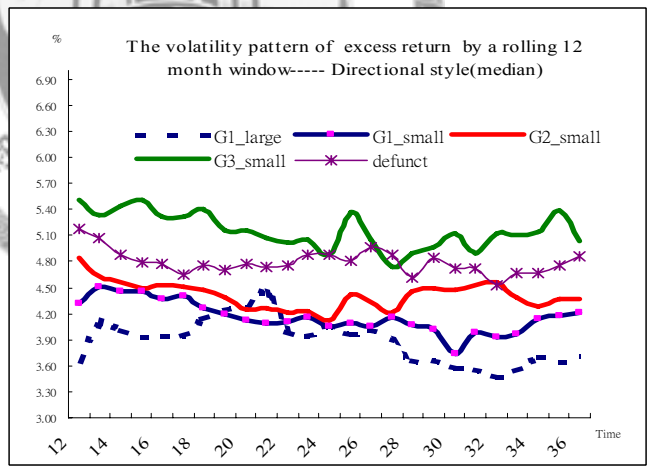
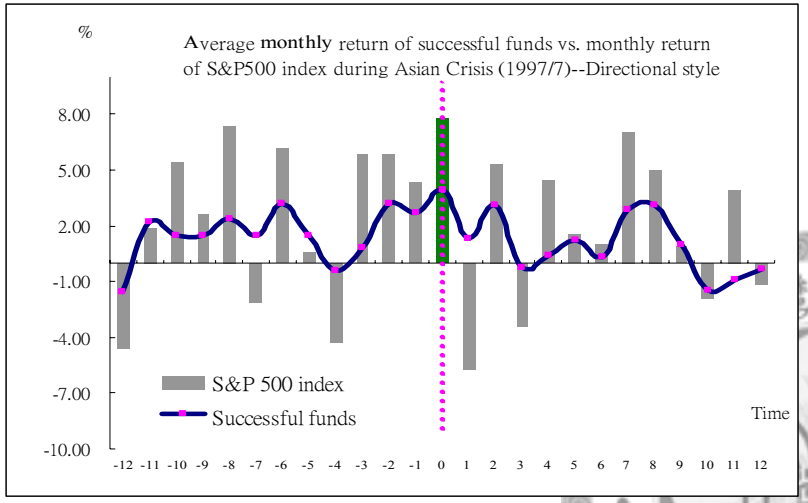
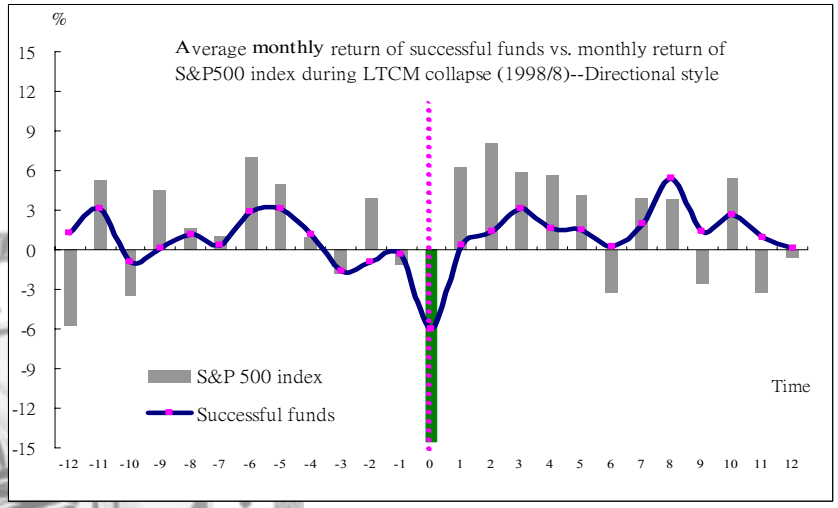
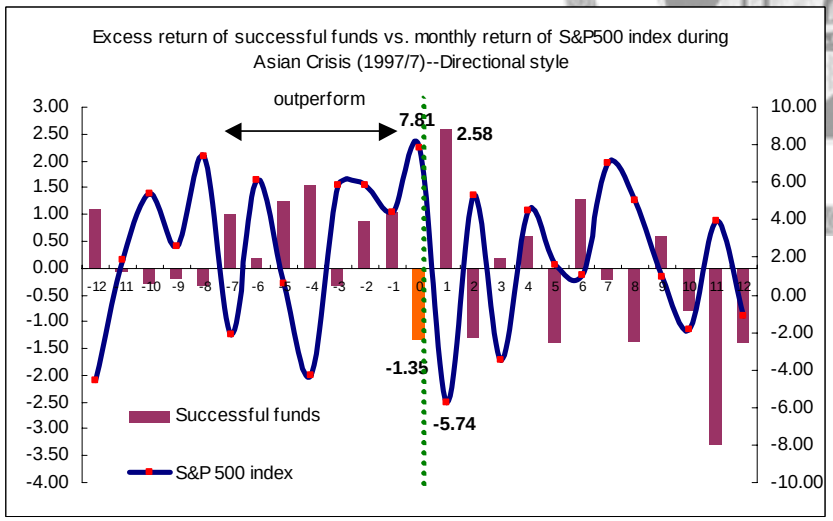



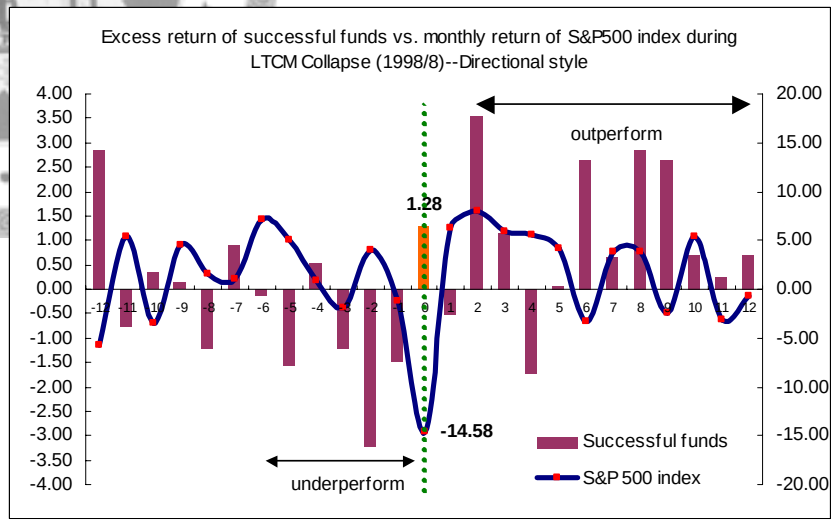
Figure 8 Trend of absolute and relative average returns of successful funds around 12 months as great financial shock took place

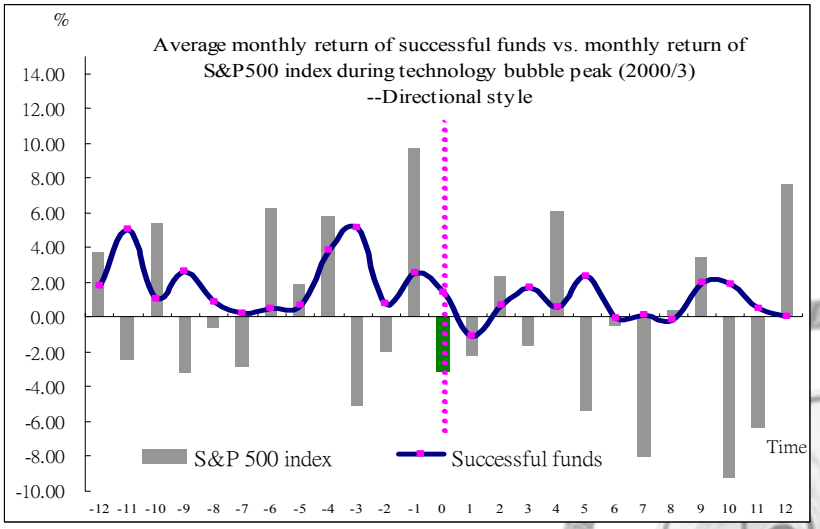
Panel A Directional type

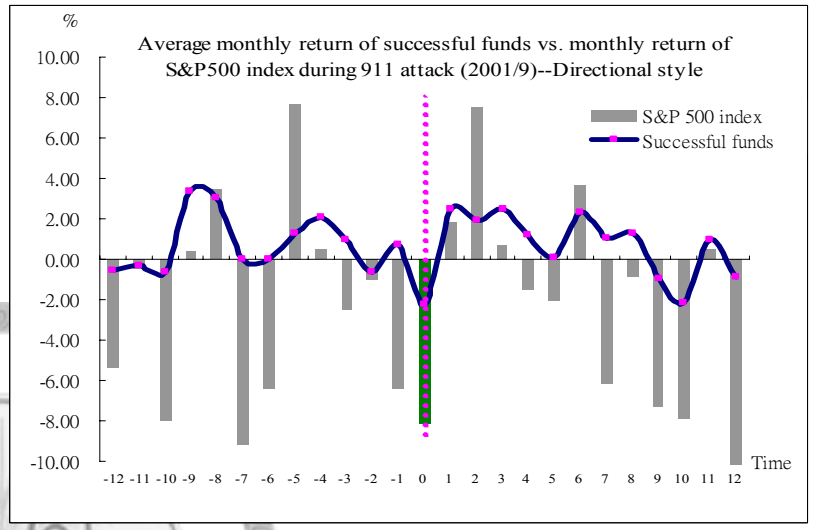


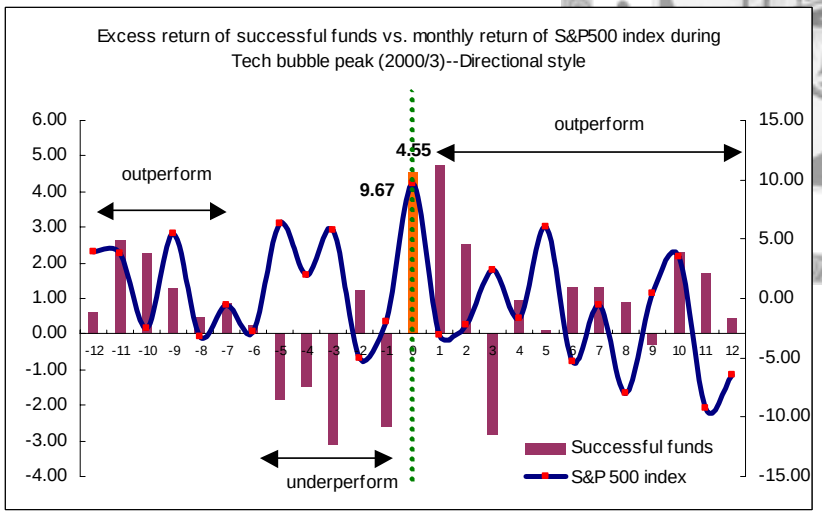



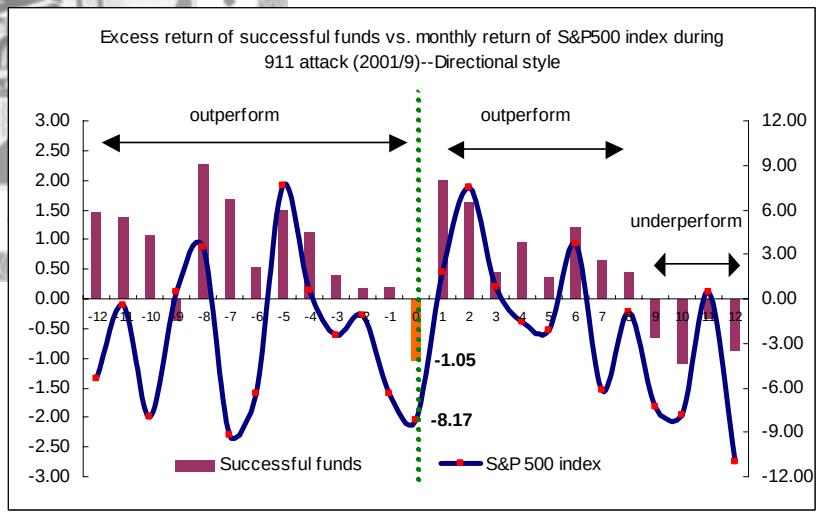



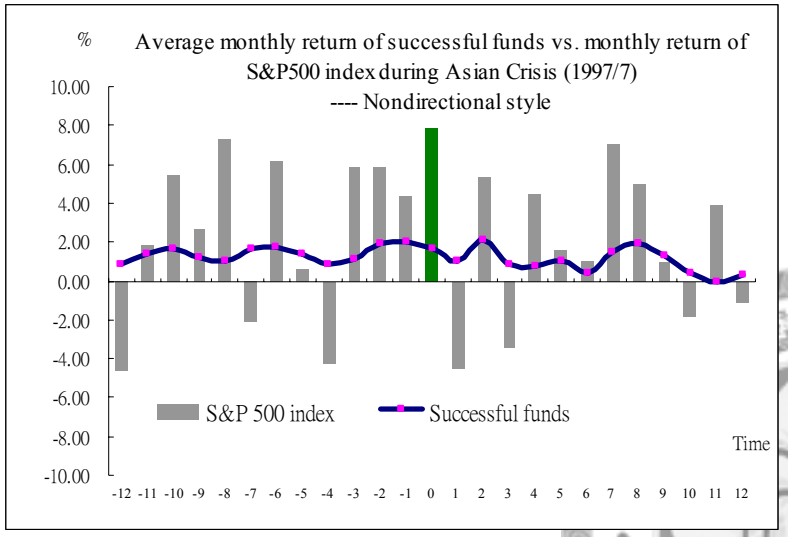

%
Average monthly return of successful funds vs. monthly return of S&P500 index during technology bubble peak (2000/3) --Directional style
S&P 500 index
Successful funds
Time

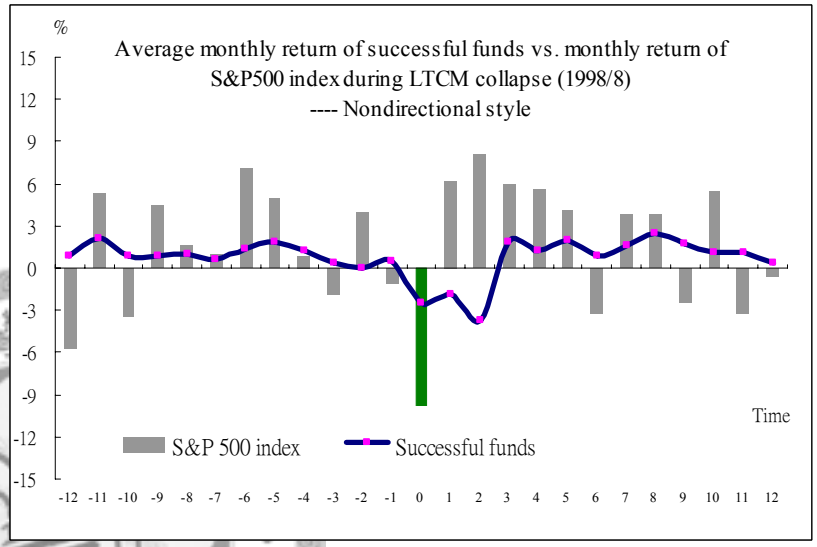

%
Average monthly return of successful funds vs. monthly return of S&P500 index during 911 attack (2001/9)--Directional style
S&P 500 index
Successful funds
Time

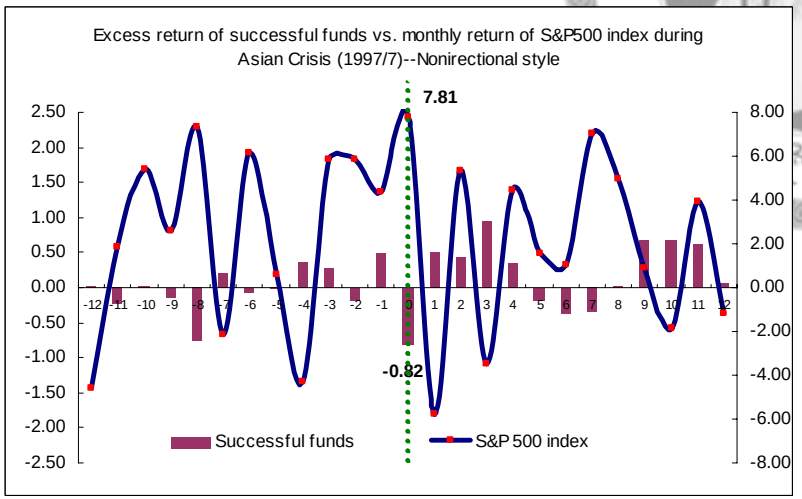

Excess return of successful funds vs. monthly return of S&P500 index during Tech bubble peak (2000/3)--Directional style
outperform
outperform
underperform
4.55
9.67
Successful funds
S&P 500 index

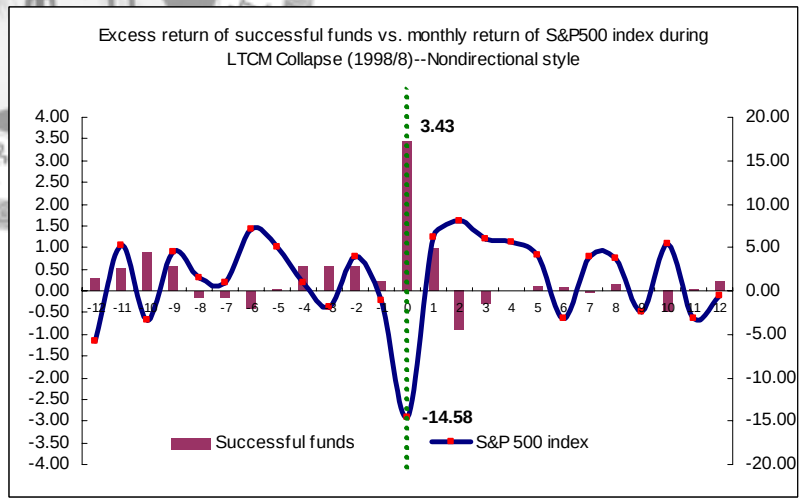

Excess return of successful funds vs. monthly return of S&P500 index during 911 attack (2001/9)--Directional style
outperform
outperform
underperform
-1.05
-8.17
Successful funds
S&P 500 index

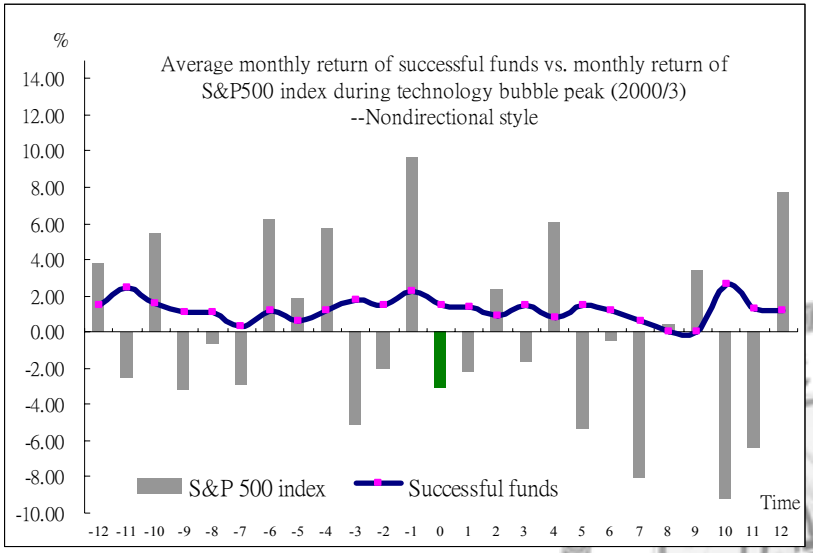
Panel B Non-directional type

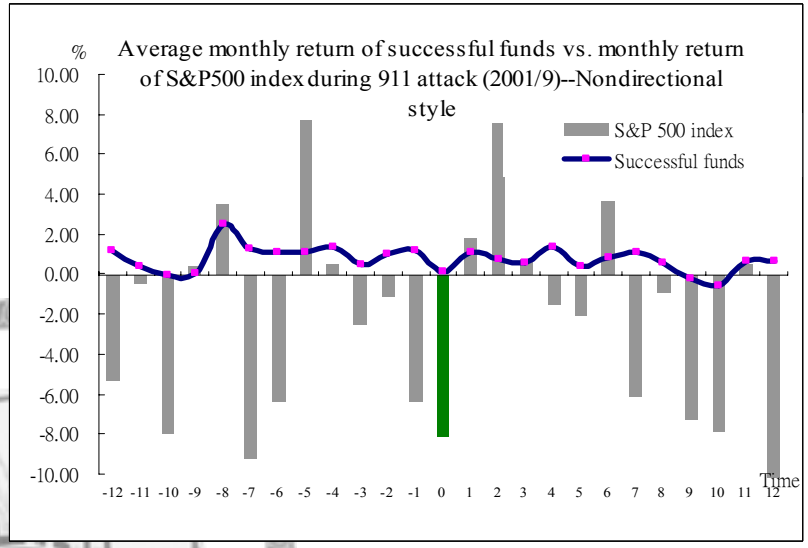


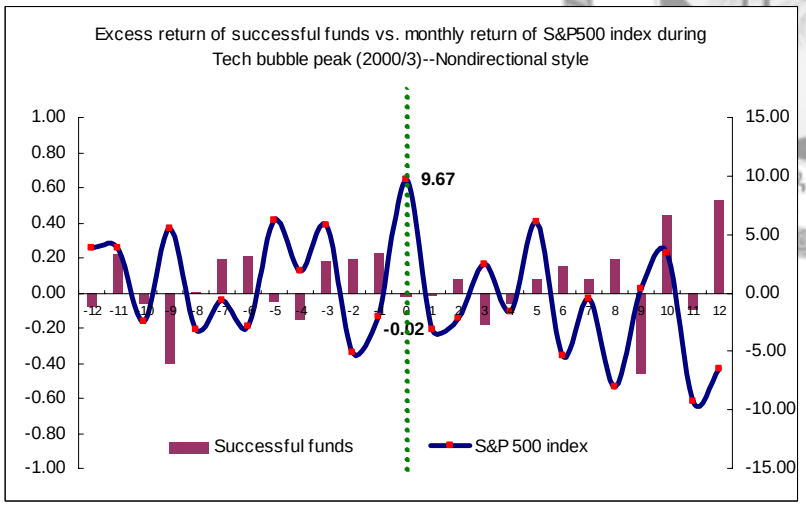




%
Average monthly return of successful funds vs. monthly return of S&P500 index during technology bubble peak (2000/3) --Nondirectional style
S&P 500 index
Successful funds
Time


%
Average monthly return of successful funds vs. monthly return of S&P500 index during 911 attack (2001/9)--Nondirectional style
S&P 500 index
Successful funds
Time


Excess return of successful funds vs. monthly return of S&P500 index during Tech bubble peak (2000/3)--Nondirectional style
9.67
-0.02
Successful funds
S&P 500 index

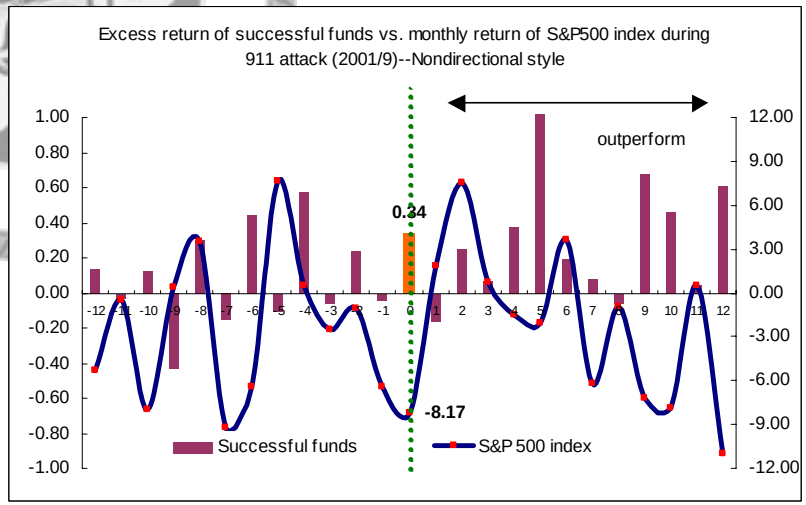

Excess return of successful funds vs. monthly return of S&P500 index during 911 attack (2001/9)--Nondirectional style
outperform
0.24
-8.17
Successful funds
S&P 500 index

Table 15 Mean and median of performance and risk parameter estimates of hedge funds by the market-timing model during 1994 to 2004

| Style | Group | Performance (annul return ) | | | | | | | | | Risk | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jensen's alpha (α1) | | | | Alpha2 ($\alpha_2$) | | | | $\alpha_2 - \alpha_1 > 0$ ; α1>0 α2 >0 | β1(Up market beta) | | | | β2(up market beta-down market beta) | | | |
| | | Mean | Median | Significant Proportion | | Mean | Median | Significant Proportion | | | Mean | Median | Significant Proportion | | Mean | Median | Significant Proportion | |
| | | | | Postive | Negative | | | Postive | Negative | Proportion | | | Postive | Negative | | | Postive | Negative |
| Directional style (Inception date before 1999/12) | | | | | | | | | | | | | | | | | | |
| Live funds | group 1 | 9.05 | 7.55 | 52.59% | 0.00% | 8.17 | 7.31 | 38.79% | 2.59% | 40.52% | 0.675 | 0.544 | 70.26% | 2.59% | 0.077 | 0.060 | 22.41% | 15.52% |
| | group 2 | 5.62 | 4.59 | 29.91% | 1.87% | 3.04 | -0.06 | 23.36% | 6.54% | 28.97% | 0.860 | 0.837 | 71.96% | 3.74% | 0.238 | 0.231 | 35.51% | 13.08% |
| | group 3 | 4.28 | 3.99 | 23.14% | 2.48% | 2.99 | 1.57 | 14.05% | 6.61% | 23.97% | 0.867 | 0.794 | 71.07% | 2.48% | 0.174 | 0.155 | 20.66% | 9.09% |
| Defunct funds | group 1 | 7.64 | 5.82 | 28.79% | 3.03% | 5.52 | 3.06 | 21.21% | 4.55% | 27.27% | 0.811 | 0.682 | 66.67% | 3.03% | 0.163 | 0.179 | 19.70% | 10.61% |
| | group 2 | 5.01 | 3.95 | 16.00% | 3.00% | 5.84 | 3.64 | 24.00% | 3.00% | 27.00% | 0.719 | 0.506 | 54.00% | 7.00% | -0.001 | 0.098 | 19.00% | 21.00% |
| | group 3 | -4.47 | -1.40 | 7.60% | 11.20% | -4.40 | -1.30 | 8.20% | 12.20% | 20.00% | 0.700 | 0.499 | 50.00% | 2.80% | 0.015 | 0.026 | 15.80% | 10.60% |
| Nondirectional style(Inception date before 1999/12) | | | | | | | | | | | | | | | | | | |
| Live funds | group 1 | 4.63 | 4.32 | 67.74% | 0.00% | 4.20 | 3.32 | 44.09% | 2.15% | 24.73% | 0.632 | 0.560 | 74.19% | 1.08% | 0.060 | 0.208 | 29.03% | 13.98% |
| | group 2 | 3.29 | 3.05 | 42.86% | 0.00% | 1.29 | 3.67 | 33.33% | 4.76% | 38.10% | 0.868 | 0.486 | 54.76% | 0.00% | 0.208 | 0.069 | 9.52% | 4.76% |
| | group 3 | 2.86 | 2.15 | 38.98% | 3.39% | 0.83 | 1.34 | 23.73% | 10.17% | 22.03% | 0.716 | 0.496 | 57.63% | 1.69% | 0.348 | 0.168 | 16.95% | 5.08% |
| Defunct funds | group 1 | 4.04 | 4.77 | 56.52% | 8.70% | 5.00 | 5.18 | 39.13% | 4.35% | 39.13% | 0.842 | 0.340 | 39.13% | 0.00% | -0.240 | -0.021 | 4.35% | 8.70% |
| | group 2 | 5.56 | 4.13 | 42.42% | 15.15% | 3.89 | 3.15 | 30.30% | 18.18% | 21.21% | 0.842 | 0.533 | 42.42% | 6.06% | -0.027 | 0.356 | 18.18% | 15.15% |
| | group 3 | -2.24 | -0.66 | 12.26% | 21.94% | -3.57 | -1.91 | 13.55% | 14.19% | 24.52% | 0.730 | 0.448 | 32.90% | 3.87% | 0.581 | 0.048 | 9.68% | 5.81% |

Table 16 Statistics of recovering from losses of each group from January 1994 to November 2004.

| Style | Group | Capability of recovering from losses | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Maximum monthly loss | | | | | | | | Maximum drawdown | | | Average drawdown | |
| | | Recovery Proportion | Recovery time (Month) | | Recovery rate ( RC) | | | Time between closure and occurrence of losses for uncovering funds (month) | | Recovery Proportion | Recovery time (month) | | Recovery time (month) | |
| | | | Mean | Median | Mean | Median | Ratio of postive dif_RC | Mean | Median | | Mean | Median | Mean | Median |
| Directional style (Inception date before 1999/12) | | | | | | | | | | | | | | |
| Live funds | group 1 | 90% | 10.4 | 6.0 | 0.759 | 0.816 | 59.91% | 20 | 8 | 88% | 14 | 8 | 5 | 4 |
| | group 2 | 79% | 13.4 | 9.0 | 0.643 | 0.708 | 37.38% | 33 | 45 | 77% | 15 | 8 | 6 | 5 |
| | group 3 | 71% | 12.9 | 7.0 | 0.626 | 0.708 | 41.32% | 33 | 40 | 71% | 12 | 6 | 5 | 4 |
| Defunct funds | group 1 | 45% | 5.2 | 3.5 | 0.670 | 0.727 | 48.48% | 9 | 6 | 53% | 8 | 7 | 3 | 2 |
| | group 2 | 41% | 6.7 | 3.0 | 0.618 | 0.638 | 53.00% | 10 | 6 | 48% | 8 | 4 | 4 | 3 |
| | group 3 | 35% | 7.1 | 5.0 | 0.493 | 0.500 | 41.60% | 10 | 6 | 41% | 9 | 5 | 4 | 3 |
| Nondirectional style(Inception date before 1999/12) | | | | | | | | | | | | | | |
| Live funds | group 1 | 95% | 7.6 | 5.0 | 0.871 | 0.901 | 60.22% | 8 | 6 | 89% | 8 | 4 | 4 | 3 |
| | group 2 | 98% | 7.4 | 5.0 | 0.840 | 0.870 | 52.38% | 3 | 3 | 88% | 10 | 7 | 4 | 3 |
| | group 3 | 78% | 7.5 | 5.0 | 0.781 | 0.855 | 37.29% | 29 | 16 | 80% | 9 | 5 | 4 | 4 |
| Defunct funds | group 1 | 52% | 3.7 | 2.0 | 0.864 | 0.880 | 60.87% | 4 | 2 | 48% | 4 | 3 | 4 | 2 |
| | group 2 | 52% | 6.0 | 5.0 | 0.782 | 0.878 | 57.58% | 7 | 1 | 52% | 5 | 5 | 3 | 3 |
| | group 3 | 38% | 6.8 | 5.0 | 0.597 | 0.632 | 24.52% | 8 | 6 | 43% | 9 | 5 | 3 | 3 |

Note: Ratio of exceeding market indicates the ratio of positive numbers of dif_RC to all

Table 17 Measure of recovering from losses and the proportion of no recovery from losses after T months when the maximum losses occurred..

| Style | | Group | Maximum loss(median) | The degree of recovering loss Rd (median) | | | | The proportation of unrecovering loss * | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 3 month | 6 month | 9 month | 12 month | 3 month | 6 month | 9 month | 12 month |
| Directional style | live | Group1 | -10.17 | 0.40 | 0.86 | 1.27 | 1.60 | 29% | 22% | 17% | 17% |
| | | Group2 | -12.68 | 0.14 | 0.35 | 0.64 | 0.91 | 42% | 32% | 27% | 27% |
| | | Group3 | -14.74 | 0.28 | 0.41 | 0.84 | 1.03 | 39% | 35% | 31% | 29% |
| | defunct1 | Group1 | -10.74 | 0.50 | 0.93 | 0.87 | 1.56 | 35% | 23% | 33% | 28% |
| | | Group2 | -12.63 | 0.53 | 0.67 | 1.06 | 0.92 | 23% | 17% | 21% | 21% |
| | | Group3 | -13.50 | 0.25 | 0.48 | 0.67 | 0.79 | 35% | 30% | 29% | 28% |
| | defunct2 | Group1 | -9.39 | 0.01 | 0.13 | 0.11 | 0.28 | 50% | 47% | 44% | 40% |
| | | Group2 | -11.35 | 0.00 | -0.19 | 0.21 | -0.49 | 62% | 54% | 41% | 60% |
| | | Group3 | -13.10 | 0.00 | 0.00 | -0.12 | -0.08 | 59% | 51% | 55% | 53% |
| Nondirectional style | live | Group1 | -3.95 | 0.27 | 1.17 | 2.27 | 2.82 | 30% | 16% | 4% | 5% |
| | | Group2 | -4.20 | 0.39 | 1.14 | 2.01 | 2.80 | 22% | 8% | 8% | 8% |
| | | Group3 | -5.96 | 0.37 | 0.92 | 1.49 | 1.80 | 38% | 23% | 17% | 15% |
| | defunct1 | Group1 | -4.58 | 1.27 | 2.62 | 3.44 | 4.50 | 18% | 9% | 9% | 9% |
| | | Group2 | -5.98 | 0.78 | 1.70 | 1.95 | 2.41 | 20% | 13% | 7% | 7% |
| | | Group3 | -6.75 | 0.32 | 0.57 | 1.10 | 1.18 | 39% | 29% | 26% | 24% |
| | defunct2 | Group1 | -7.05 | -0.11 | -0.57 | 4.98 | na | 73% | 67% | 50% | 0% |
| | | Group2 | -8.65 | 0.00 | 0.85 | 1.94 | 1.77 | 53% | 29% | 0% | 0% |
| | | Group3 | -8.33 | 0.00 | 0.28 | 0.14 | 0.12 | 55% | 38% | 44% | 47% |

Note : The proportion of unrecovering loss * =the numbers of negative Rd/ the numbers of all samples

Table 18 Survival estimates and mean survival time of hedge funds by the Kaplan-Meier method

Panel A: Survival estimates

| Life time Interval (lower, upper) unit:month | Survival function by Kaplan-Meier estimation | | | | | | |
|---|---|---|---|---|---|---|---|
| | All Funds | Directional funds | | | Nondirectional funds | | |
| | | All | Large | Small | All | Large | Small |
| 0-12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 12-24 | 0.994 | 0.994 | 0.999 | 0.989 | 0.993 | 0.997 | 0.989 |
| 24-36 | 0.891 | 0.882 | 0.964 | 0.801 | 0.910 | 0.975 | 0.843 |
| 36-48 | 0.785 | 0.771 | 0.917 | 0.629 | 0.821 | 0.941 | 0.702 |
| 48-60 | 0.699 | 0.679 | 0.873 | 0.492 | 0.749 | 0.896 | 0.594 |
| 60-72 | 0.611 | 0.593 | 0.810 | 0.389 | 0.658 | 0.849 | 0.461 |
| 72-84 | 0.535 | 0.515 | 0.754 | 0.296 | 0.588 | 0.792 | 0.376 |
| 84-96 | 0.472 | 0.450 | 0.700 | 0.229 | 0.532 | 0.750 | 0.308 |
| 96-108 | 0.427 | 0.404 | 0.666 | 0.176 | 0.489 | 0.704 | 0.266 |
| 108-120 | 0.384 | 0.369 | 0.638 | 0.140 | 0.427 | 0.623 | 0.216 |
| 120-132 | 0.357 | 0.342 | 0.629 | 0.114 | 0.368 | 0.623 | 0.118 |
| 132-144 | 0.348 | 0.326 | 0.629 | 0.100 | 0.368 | 0.623 | 0.118 |
| Log-Rank | Style | 9.40 | Size | 395.47 | | | 124.74 |
| P value | | 0.0022 | | <.0001 | | | <.0001 |

Note: 1.Large(small) directional (nondirectional) funds are those with average AUM above (below) the median AUM of all directional (nondirectional) funds.
2.Log-rank test for style (size) is testing the difference of survival function between the directional(large sized) and the non-directional (small sized) funds.

Panel B: Estimated mean survival time in months

| Type | Group | Mean | S.E |
|---|---|---|---|
| Directional | All | 82.4 | 1.29 |
| | Large | 94.5 | 1.21 |
| | Small | 59.5 | 1.46 |
| Nondirectional | All | 88.9 | 2.03 |
| | Large | 99.5 | 1.89 |
| | Small | 67.7 | 2.64 |
| All funds | | 84.4 | 1.09 |

Table 19 Covariate tests for the log-rank test Kaplan-Meier model (1994-2004)

Panel A:Univariate Chi-squares for the log rank test

| Covariables | ALL funds | | | | Directional funds | | | | Nondirectional funds | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Signs of test stastic | Chi-Square | Pr >Chi-Square | | Signs of test stastic | Chi-Square | Pr >Chi-Square | | Signs of test stastic | Chi-Square | Pr >Chi-Square | |
| Audit | + | 435.6 | <.0001 | '** | + | 304.0 | <.0001 | *** | + | 126.2 | <.0001 | *** |
| High water mark | + | 188.1 | <.0001 | '** | + | 152.5 | <.0001 | *** | + | 34.8 | <.0001 | *** |
| Leveraged | - | 22.5 | <.0001 | '** | - | 22.5 | <.0001 | *** | - | 1.42 | 0.23 | |
| Lockup time | + | 54.0 | <.0001 | '** | + | 33.8 | <.0001 | *** | + | 21.1 | <.0001 | *** |
| redemption time | + | 11.8 | 0.0006 | '** | + | 11.9 | 0.001 | *** | + | 0.5 | 0.47 | |
| Own capitals | - | 6.3 | 0.0119 | ** | - | 0.8 | 0.37 | | - | 10.1 | 0.002 | *** |
| Minimum investment | + | 29.5 | <.0001 | '** | + | 15.4 | <.0001 | *** | + | 11.5 | 0.001 | *** |
| Fee | - | 0.4 | 0.53 | | - | 0.4 | 0.55 | | - | 0.37 | 0.54 | |
| Incentive fee | - | 0.1 | 0.7174 | | - | 0.0 | 0.87 | | - | 0.37 | 0.54 | |
| Average monthly AUMs | + | 131.7 | <.0001 | *** | + | 96.9 | <.0001 | *** | + | 36.8 | <.0001 | *** |
| Average monthly return | + | 271.4 | <.0001 | *** | + | 236.7 | <.0001 | *** | + | 45.0 | <.0001 | *** |
| Average monthly active return | + | 253.4 | <.0001 | *** | + | 209.2 | <.0001 | *** | + | 51.2 | <.0001 | *** |
| StdDev(return) | - | 86.0 | <.0001 | *** | - | 44.9 | <.0001 | *** | - | 58.0 | <.0001 | *** |
| StdDev(active return) | - | 128.2 | <.0001 | *** | - | 78.5 | <.0001 | *** | - | 62.3 | <.0001 | *** |
| d_recover | + | 623.8 | <.0001 | *** | + | 432.6 | <.0001 | *** | + | 185.4 | <.0001 | *** |
| RC | + | 499.3 | <.0001 | *** | + | 311.1 | <.0001 | *** | + | 223.7 | <.0001 | *** |
| Dif_RC | + | 35.1 | <.0001 | *** | + | 4.5 | 0.03 | *** | + | 124.0 | <.0001 | *** |
| Favorable position(Quarter) | + | 10.6 | 0.0011 | *** | + | 42.9 | <.0001 | *** | + | 1.5 | 0.22 | |
| Flow_Quarter | + | 0.2 | 0.6172 | | + | 2.3 | 0.13 | | + | 0.1 | 0.77 | |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Panel B: Forward stepwise sequence of Chi-squares for the log rank test

| Covariables | ALL funds | | Directional funds | | Nondirectional funds | |
|---|---|---|---|---|---|---|
| | Increment Chi-Square | Pr >Increment | Increment Chi-Square | Pr >Increment | Chi-Square | Pr >Chi-Square |
| Audit | 346.7 | <.0001 *** | 241.9 | <.0001 *** | 126.2 | <.0001 *** |
| High water mark | 100.8 | <.0001 *** | 81.5 | <.0001 *** | 34.8 | <.0001 *** |
| Leveraged | 21.56 | <.0001 *** | 15.9 | <.0001 *** | 1.42 | 0.23 |
| Lockup time | 3.22 | 0.073 * | 0.29 | 0.587 | 21.1 | <.0001 *** |
| redemption time | 1.03 | 0.310 | 0.01 | 0.904 | 0.5 | 0.47 |
| Own capitals | 1.67 | 0.196 | 1.16 | 0.282 | 10.1 | 0.002 *** |
| Minimum investment | 0.04 | 0.847 | 0.09 | 0.767 | 11.5 | 0.001 *** |
| Fee | 6.99 | 0.008 *** | 2.52 | 0.113 | 0.37 | 0.54 |
| Incentive fee | 7.59 | 0.006 *** | 4.81 | 0.028 ** | 0.37 | 0.54 |
| Average monthly AUMs | 9.77 | 0.002 *** | 8.99 | 0.003 *** | 36.8 | <.0001 *** |
| Average monthly return | 4.70 | 0.030 ** | 68.8 | <.0001 *** | 45.0 | <.0001 *** |
| Average monthly active return | 59.2 | <.0001 *** | 39.0 | <.0001 *** | 51.2 | <.0001 *** |
| StdDev(return) | 16.3 | <.0001 *** | 13.0 | 0.00 *** | 58.0 | <.0001 *** |
| StdDev(active return) | 18.1 | <.0001 *** | 46.0 | <.0001 *** | 62.3 | <.0001 *** |
| d_recover | 623.8 | <.0001 *** | 432.6 | <.0001 *** | 185.4 | <.0001 *** |
| RC | 105.8 | <.0001 *** | 85.4 | <.0001 *** | 223.7 | <.0001 *** |
| Dif_RC | 105.4 | <.0001 *** | 59.6 | <.0001 *** | 124.0 | <.0001 *** |
| Favorable position(Quarter) | 6.4 | 0.011 ** | 3.9 | 0.05 *** | 1.5 | 0.22 |
| Flow_Quarter | 0.0 | 0.908 | 0.3 | 0.61 | 0.1 | 0.77 |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Table 20 Hazard ratios from the Cox PH model with time dependent covariates from 1994-2004

| Classification | Covariables | ALL funds | | | | Directional funds | | | | Nondirectional funds | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Parameter estimation | Hazard ratio | Pr >Chi-Square | | Parameter estimation | Hazard ratio | Pr >Chi-Square | | Parameter estimation | Hazard ratio | Pr >Chi-Square | |
| Character-istics | Audit | -1.000 | 0.368 | <.0001 | *** | -0.939 | 0.391 | <.0001 | *** | -1.168 | 0.311 | <.0001 | *** |
| | High water mark | -0.669 | 0.512 | <.0001 | *** | -0.752 | 0.471 | <.0001 | *** | -0.424 | 0.654 | 0.004 | *** |
| | Leveraged | 0.379 | 1.461 | <.0001 | *** | 0.387 | 1.472 | <.0001 | *** | 0.362 | 1.436 | 0.021 | *** |
| | Lockup time | -0.020 | 0.980 | 0.009 | *** | -0.011 | 0.989 | 0.178 | | -0.045 | 0.956 | 0.007 | *** |
| | Redemption time | 0.003 | 1.003 | 0.809 | | -0.005 | 0.995 | 0.801 | | 0.012 | 1.012 | 0.603 | |
| | Own capitals | -0.144 | 0.866 | 0.035 | ** | -0.196 | 0.822 | 0.013 | ** | 0.088 | 1.092 | 0.536 | |
| | Minimum investment | -0.002 | 0.998 | 0.966 | | 0.010 | 1.010 | 0.832 | | -0.046 | 0.955 | 0.543 | |
| | Incentive fee | 0.013 | 1.013 | 0.053 | * | 0.010 | 1.010 | 0.194 | | 0.019 | 1.019 | 0.182 | |
| | Fee | -0.086 | 0.917 | 0.049 | ** | -0.090 | 0.914 | 0.057 | * | -0.218 | 0.804 | 0.138 | * |
| | AUMs(t) | -0.003 | 0.997 | <.0001 | *** | -0.004 | 0.996 | <.0001 | *** | -0.001 | 0.999 | 0.085 | * |
| Performance /Risk | Ret_year(t) | -0.005 | 0.995 | 0.0153 | *** | -0.008 | 0.992 | 0.0006 | *** | 0.001 | 1.001 | 0.6812 | |
| | under_year(t) | 0.607 | 1.835 | <.0001 | *** | 0.464 | 1.590 | <.0001 | *** | 0.898 | 2.454 | <.0001 | *** |
| | Alpha_year(t) | -0.208 | 0.812 | <.0001 | *** | -0.195 | 0.823 | <.0001 | *** | -0.209 | 0.812 | <.0001 | *** |
| | Ex_std_ret(t) | -0.010 | 0.990 | 0.268 | | -0.012 | 0.988 | 0.221 | | -0.026 | 0.974 | 0.319 | |
| | Std_ret(t) | 0.025 | 1.025 | 0.001 | *** | 0.024 | 1.024 | 0.004 | *** | 0.077 | 1.080 | 0.003 | *** |
| Recoverable ability | d_recover(t) | -0.434 | 0.648 | <.0001 | *** | -0.376 | 0.687 | 0.000 | *** | -0.569 | 0.566 | 0.002 | *** |
| | RC(t) | -0.552 | 0.576 | 0.002 | *** | -0.726 | 0.484 | 0.000 | *** | -0.078 | 0.925 | 0.878 | |
| | Dif_RC(t) | -0.003 | 0.997 | 0.983 | | 0.380 | 1.462 | 0.023 | ** | -0.987 | 0.373 | 0.028 | ** |
| Flow and competition | Fav_Quarter | -0.207 | 0.813 | 0.0363 | ** | -0.001 | 0.999 | 0.994 | | -0.561 | 0.571 | 0.0058 | *** |
| | Flow_Quarter | -0.189 | 0.828 | 0.0523 | * | -0.392 | 0.676 | 0.0056 | *** | 0.000 | 1.000 | 0.9345 | |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Table 21 Hazard ratios from the Cox PH model with time dependent covariates from 1994-2004
Panel A: ALL funds (directional funds)

| Forecast period : One year | | Attrition rate | | | | | Annual return of portfolio | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | SR_Year | Alpha_ Year | RC | Composite | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | | | | | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 9.7% | 4.2% | 4.2% | 4.2% | 0.0% | 16.04 | 20.22 | 11.66 | 10.26 | 27.05 | 30.32 | 14.73 | 12.74 | 24.72 | 22.94 |
| Dec-97 | 1998 | 13.5% | 8.3% | 8.3% | 8.3% | 0.0% | 2.45 | -8.60 | 6.65 | 1.47 | -6.19 | -33.74 | 7.60 | 1.65 | 2.17 | -27.76 |
| Dec-98 | 1999 | 11.0% | 4.2% | 0.0% | 8.3% | 0.0% | 27.44 | 29.77 | 37.70 | 41.07 | 56.65 | 54.20 | 20.33 | 21.04 | 29.17 | 29.35 |
| Dec-99 | 2000 | 13.8% | 8.3% | 8.3% | 4.3% | 0.0% | 7.29 | 3.88 | 12.94 | 10.78 | -1.19 | -4.64 | 15.71 | 3.37 | 6.70 | -0.62 |
| Dec-00 | 2001 | 15.1% | 4.2% | 0.0% | 8.3% | 0.0% | 3.81 | 2.07 | 11.05 | 12.18 | 14.36 | 13.87 | 6.26 | 3.03 | 8.89 | 6.88 |
| Dec-01 | 2002 | 14.3% | 4.2% | 4.2% | 12.5% | 0.0% | 1.10 | 0.12 | 17.96 | 13.52 | 19.99 | 9.90 | 4.08 | 3.85 | 4.93 | 1.77 |
| Dec-02 | 2003 | 11.6% | 8.3% | 4.2% | 4.3% | 4.2% | 20.62 | 17.10 | 17.64 | 10.66 | 23.01 | 19.94 | 17.34 | 10.13 | 16.58 | 12.46 |
| Average | | 12.7% | 6.0% | 4.2% | 7.2% | 0.6% | 11.25 | 9.22 | 16.51 | 14.28 | 19.10 | 12.84 | 12.29 | 7.97 | 13.31 | 6.43 |
| Forecast period : Two year | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 22.6% | 20.8% | 12.5% | 18.2% | 0.0% | 8.47 | 6.23 | 0.96 | 0.11 | 10.70 | 4.57 | 6.45 | 3.90 | 9.53 | 3.68 |
| Dec-97 | 1998-1999 | 23.6% | 12.5% | 8.3% | 20.8% | 0.0% | 14.42 | 11.73 | 13.75 | 13.39 | 13.51 | 13.42 | 13.46 | 8.12 | 10.51 | 6.02 |
| Dec-98 | 1999-2000 | 23.4% | 8.3% | 8.3% | 13.6% | 4.2% | 17.59 | 16.97 | 27.51 | 26.06 | 26.20 | 24.26 | 18.16 | 17.65 | 19.68 | 18.90 |
| Dec-99 | 2000-2001 | 26.0% | 12.5% | 16.7% | 17.4% | 4.2% | 5.64 | 2.77 | 7.45 | 7.42 | -5.81 | -6.45 | 9.66 | 2.90 | 2.76 | -0.95 |
| Dec-00 | 2001-2002 | 27.3% | 12.5% | 8.3% | 25.0% | 0.0% | 2.29 | 0.93 | 10.07 | 7.79 | 8.25 | 7.42 | 4.26 | 2.56 | 5.92 | 2.37 |
| Dec-01 | 2002-2003 | 23.8% | 8.3% | 12.5% | 20.8% | 4.2% | 11.34 | 9.14 | 20.26 | 13.37 | 30.15 | 20.59 | 8.76 | 10.13 | 9.72 | 7.93 |
| Dec-02 | 2003-2004 | 18.3% | 8.3% | 4.2% | 4.3% | 8.3% | 14.52 | 12.11 | 16.00 | 11.42 | 18.63 | 14.23 | 16.45 | 11.44 | 14.51 | 10.27 |
| Average | | 23.6% | 11.9% | 10.1% | 17.2% | 3.0% | 10.61 | 8.55 | 13.72 | 11.36 | 14.52 | 11.15 | 11.03 | 8.10 | 10.38 | 6.89 |

| Forecast period : One year | | Standard deviation of monthly return | | | | | | | | | | Mean return / standard deviation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | | SR_Year | | Alpha_Year | | RC | | Composite | | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 2.56 | 2.63 | 1.72 | 1.45 | 3.16 | 3.96 | 1.38 | 1.27 | 2.56 | 2.68 | 0.52 | 0.64 | 0.57 | 0.59 | 0.71 | 0.64 | 0.89 | 0.84 | 0.80 | 0.71 |
| Dec-97 | 1998 | 2.77 | 3.55 | 2.53 | 2.73 | 4.95 | 5.44 | 1.34 | 2.45 | 3.50 | 4.93 | 0.07 | -0.20 | 0.22 | 0.04 | -0.10 | -0.52 | 0.47 | 0.06 | 0.05 | -0.47 |
| Dec-98 | 1999 | 2.74 | 3.11 | 2.45 | 3.48 | 4.84 | 5.08 | 1.11 | 1.24 | 2.60 | 2.61 | 0.84 | 0.80 | 1.28 | 0.98 | 0.98 | 0.89 | 1.53 | 1.42 | 0.94 | 0.94 |
| Dec-99 | 2000 | 2.77 | 3.19 | 2.46 | 2.15 | 9.12 | 7.34 | 2.28 | 2.85 | 5.09 | 4.40 | 0.22 | 0.10 | 0.44 | 0.42 | -0.01 | -0.05 | 0.57 | 0.10 | 0.11 | -0.01 |
| Dec-00 | 2001 | 1.72 | 1.33 | 0.53 | 1.29 | 1.22 | 2.21 | 0.53 | 0.71 | 0.32 | 0.91 | 0.18 | 0.13 | 1.75 | 0.79 | 0.98 | 0.52 | 0.99 | 0.35 | 2.30 | 0.63 |
| Dec-01 | 2002 | 1.36 | 1.06 | 1.03 | 0.83 | 2.65 | 2.43 | 0.71 | 0.60 | 0.86 | 1.02 | 0.07 | 0.01 | 1.45 | 1.36 | 0.63 | 0.34 | 0.48 | 0.53 | 0.48 | 0.15 |
| Dec-02 | 2003 | 1.39 | 1.17 | 0.77 | 0.72 | 1.28 | 1.27 | 0.91 | 0.56 | 0.85 | 0.66 | 1.24 | 1.22 | 1.91 | 1.23 | 1.50 | 1.31 | 1.58 | 1.52 | 1.63 | 1.58 |
| Average | | 2.19 | 2.29 | 1.64 | 1.81 | 3.89 | 3.96 | 1.18 | 1.38 | 2.25 | 2.46 | 0.45 | 0.39 | 1.09 | 0.77 | 0.67 | 0.45 | 0.93 | 0.69 | 0.90 | 0.50 |
| Forecast period : Two year | | | | | | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 2.66 | 3.15 | 2.84 | 2.60 | 3.92 | 5.59 | 2.29 | 2.63 | 3.56 | 3.83 | 0.27 | 0.17 | 0.03 | 0.00 | 0.23 | 0.07 | 0.23 | 0.12 | 0.22 | 0.08 |
| Dec-97 | 1998-1999 | 2.87 | 3.74 | 2.21 | 2.70 | 4.81 | 7.73 | 1.24 | 1.84 | 2.95 | 5.75 | 0.42 | 0.26 | 0.52 | 0.41 | 0.23 | 0.14 | 0.90 | 0.37 | 0.30 | 0.09 |
| Dec-98 | 1999-2000 | 2.75 | 3.33 | 2.81 | 4.03 | 5.57 | 6.41 | 1.46 | 1.34 | 2.69 | 2.84 | 0.53 | 0.43 | 0.82 | 0.54 | 0.39 | 0.32 | 1.03 | 1.10 | 0.61 | 0.56 |
| Dec-99 | 2000-2001 | 2.29 | 2.43 | 1.99 | 1.58 | 6.81 | 5.47 | 1.82 | 2.14 | 3.69 | 3.28 | 0.21 | 0.10 | 0.31 | 0.39 | -0.07 | -0.10 | 0.44 | 0.11 | 0.06 | -0.02 |
| Dec-00 | 2001-2002 | 1.49 | 1.18 | 0.56 | 1.12 | 1.23 | 2.08 | 0.70 | 0.68 | 0.62 | 1.27 | 0.13 | 0.07 | 1.51 | 0.58 | 0.56 | 0.30 | 0.51 | 0.32 | 0.80 | 0.16 |
| Dec-01 | 2002-2003 | 1.63 | 1.37 | 1.16 | 0.69 | 2.41 | 2.15 | 0.87 | 0.79 | 0.93 | 1.03 | 0.58 | 0.56 | 1.46 | 1.62 | 1.04 | 0.80 | 0.84 | 1.07 | 0.87 | 0.64 |
| Dec-02 | 2003-2004 | 1.63 | 1.39 | 0.78 | 0.73 | 1.43 | 1.48 | 0.91 | 0.67 | 0.87 | 0.87 | 0.74 | 0.73 | 1.72 | 1.30 | 1.09 | 0.80 | 1.51 | 1.42 | 1.39 | 0.98 |
| Average | | 2.19 | 2.37 | 1.76 | 1.92 | 3.74 | 4.41 | 1.33 | 1.44 | 2.19 | 2.69 | 0.41 | 0.33 | 0.91 | 0.69 | 0.50 | 0.33 | 0.78 | 0.64 | 0.61 | 0.35 |

## Panel B: Large funds

| Forecast period : One year | | Attrition rate | | | | | Annual return of portfolio | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | SR_Year | Alpha_ Year | RC | Composite | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | | | | | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 3.03% | 4.2% | 4.2% | 0.0% | 0.0% | 17.85 | 20.40 | 11.45 | 11.55 | 28.58 | 27.71 | 12.44 | 10.48 | 21.62 | 21.47 |
| Dec-97 | 1998 | 8.64% | 4.2% | 8.3% | 4.2% | 0.0% | -5.84 | -10.54 | 2.63 | 0.27 | -36.70 | -48.46 | 0.22 | -3.21 | -1.86 | -16.54 |
| Dec-98 | 1999 | 7.66% | 4.2% | 8.3% | 4.2% | 4.2% | 28.38 | 29.81 | 43.37 | 34.37 | 47.63 | 36.52 | 21.89 | 23.33 | 24.08 | 24.40 |
| Dec-99 | 2000 | 7.14% | 0.0% | 4.2% | 0.0% | 0.0% | 5.81 | 3.45 | 15.47 | 12.07 | 2.61 | 0.55 | 13.77 | 4.00 | 13.68 | 8.88 |
| Dec-00 | 2001 | 8.89% | 4.2% | 0.0% | 4.2% | 0.0% | 2.47 | 1.84 | 10.46 | 11.63 | 11.89 | 12.53 | 6.43 | 3.88 | 5.99 | 6.38 |
| Dec-01 | 2002 | 8.48% | 0.0% | 0.0% | 12.5% | 0.0% | 0.13 | -0.01 | 17.40 | 11.52 | 16.74 | 8.62 | 2.78 | 2.74 | 4.92 | 3.40 |
| Dec-02 | 2003 | 9.50% | 12.5% | 0.0% | 8.3% | 4.2% | 18.81 | 16.83 | 17.15 | 11.42 | 15.86 | 9.48 | 16.08 | 10.50 | 14.44 | 10.75 |
| Average | | 7.6% | 4.2% | 3.6% | 4.8% | 1.2% | 9.66 | 8.83 | 16.85 | 13.26 | 12.37 | 6.71 | 10.51 | 7.39 | 11.84 | 8.39 |
| Forecast period : Two year | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 11.4% | 12.5% | 16.7% | 8.7% | 0.0% | 7.15 | 5.90 | -2.63 | -2.91 | 5.86 | 8.14 | 5.13 | 3.88 | 6.65 | 2.89 |
| Dec-97 | 1998-1999 | 18.2% | 4.2% | 12.5% | 12.5% | 0.0% | 11.86 | 11.23 | 9.59 | 12.31 | 6.66 | 6.88 | 8.85 | 8.04 | 11.34 | 10.04 |
| Dec-98 | 1999-2000 | 17.2% | 8.3% | 12.5% | 8.7% | 8.3% | 17.27 | 16.71 | 27.21 | 22.46 | 22.80 | 18.10 | 19.47 | 19.70 | 18.56 | 16.82 |
| Dec-99 | 2000-2001 | 17.0% | 4.2% | 12.5% | 8.3% | 4.3% | 3.84 | 2.39 | 9.13 | 8.29 | -7.42 | -3.72 | 8.57 | 3.53 | 3.88 | 4.35 |
| Dec-00 | 2001-2002 | 20.9% | 8.3% | 4.2% | 18.2% | 0.0% | 0.27 | 0.60 | 8.43 | 7.31 | 10.22 | 7.99 | 3.98 | 2.65 | 3.38 | 1.76 |
| Dec-01 | 2002-2003 | 18.5% | 4.2% | 4.2% | 19.2% | 12.5% | 10.01 | 8.91 | 18.51 | 11.55 | 25.50 | 17.83 | 8.16 | 8.61 | 8.55 | 7.54 |
| Dec-02 | 2003-2004 | 14.3% | 12.5% | 0.0% | 8.3% | 16.7% | 13.58 | 11.98 | 15.80 | 12.15 | 15.13 | 9.37 | 15.06 | 11.55 | 12.90 | 8.66 |
| Average | | 16.8% | 7.7% | 8.9% | 12.0% | 6.0% | 9.14 | 8.25 | 12.29 | 10.17 | 11.25 | 9.23 | 9.89 | 8.28 | 9.32 | 7.44 |

| Forecast period : One year | | Standard deviation of monthly return | | | | | | | | | | Mean return / standard deviation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | | SR_Year | | Alpha_Year | | RC | | Composite | | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 2.92 | 2.66 | 1.54 | 1.39 | 4.47 | 3.95 | 1.33 | 1.22 | 2.43 | 2.48 | 0.51 | 0.64 | 0.62 | 0.69 | 0.53 | 0.58 | 0.78 | 0.71 | 0.74 | 0.72 |
| Dec-97 | 1998 | 3.90 | 3.73 | 2.45 | 2.54 | 7.16 | 6.77 | 1.89 | 2.41 | 3.58 | 4.74 | -0.12 | -0.24 | 0.09 | 0.01 | -0.43 | -0.60 | 0.01 | -0.11 | -0.04 | -0.29 |
| Dec-98 | 1999 | 2.76 | 3.13 | 3.45 | 3.04 | 3.99 | 3.33 | 1.63 | 1.92 | 2.07 | 2.05 | 0.86 | 0.79 | 1.05 | 0.94 | 0.99 | 0.91 | 1.12 | 1.01 | 0.97 | 0.99 |
| Dec-99 | 2000 | 3.14 | 3.25 | 2.82 | 2.40 | 8.61 | 7.11 | 2.70 | 2.62 | 4.65 | 3.19 | 0.15 | 0.09 | 0.46 | 0.42 | 0.03 | 0.01 | 0.43 | 0.13 | 0.24 | 0.23 |
| Dec-00 | 2001 | 1.90 | 1.32 | 0.41 | 1.10 | 1.24 | 1.98 | 0.46 | 0.71 | 0.37 | 0.74 | 0.11 | 0.12 | 2.11 | 0.88 | 0.80 | 0.53 | 1.15 | 0.45 | 1.34 | 0.71 |
| Dec-01 | 2002 | 1.33 | 1.04 | 0.82 | 0.58 | 2.27 | 2.07 | 0.71 | 0.53 | 0.73 | 0.82 | 0.01 | 0.00 | 1.77 | 1.65 | 0.61 | 0.35 | 0.33 | 0.43 | 0.56 | 0.34 |
| Dec-02 | 2003 | 1.26 | 1.16 | 0.81 | 0.68 | 0.72 | 0.67 | 0.90 | 0.56 | 0.77 | 0.45 | 1.24 | 1.21 | 1.76 | 1.39 | 1.83 | 1.18 | 1.49 | 1.56 | 1.57 | 1.99 |
| Average | | 2.46 | 2.33 | 1.76 | 1.68 | 4.07 | 3.70 | 1.37 | 1.43 | 2.09 | 2.07 | 0.39 | 0.37 | 1.12 | 0.85 | 0.62 | 0.42 | 0.76 | 0.60 | 0.77 | 0.67 |
| Forecast period : Two year | | | | | | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 3.53 | 3.22 | 2.93 | 3.23 | 5.65 | 4.91 | 2.25 | 2.00 | 3.38 | 3.71 | 0.17 | 0.15 | -0.08 | -0.08 | 0.09 | 0.14 | 0.19 | 0.16 | 0.16 | 0.06 |
| Dec-97 | 1998-1999 | 3.82 | 3.93 | 2.04 | 2.54 | 7.65 | 8.66 | 1.57 | 1.97 | 3.18 | 4.84 | 0.26 | 0.24 | 0.39 | 0.40 | 0.07 | 0.07 | 0.47 | 0.34 | 0.30 | 0.17 |
| Dec-98 | 1999-2000 | 2.77 | 3.33 | 3.85 | 3.10 | 4.63 | 3.98 | 2.78 | 5.50 | 1.69 | 2.08 | 0.52 | 0.42 | 0.59 | 0.60 | 0.41 | 0.38 | 0.58 | 0.30 | 0.91 | 0.67 |
| Dec-99 | 2000-2001 | 2.61 | 2.46 | 2.23 | 1.80 | 6.28 | 5.04 | 2.17 | 1.97 | 3.50 | 2.39 | 0.12 | 0.08 | 0.34 | 0.38 | -0.10 | -0.06 | 0.33 | 0.15 | 0.09 | 0.15 |
| Dec-00 | 2001-2002 | 1.65 | 1.17 | 0.68 | 1.05 | 1.04 | 1.82 | 0.75 | 0.73 | 0.68 | 1.22 | 0.01 | 0.04 | 1.03 | 0.58 | 0.82 | 0.37 | 0.44 | 0.30 | 0.42 | 0.12 |
| Dec-01 | 2002-2003 | 1.54 | 1.35 | 1.06 | 0.61 | 1.97 | 1.79 | 0.89 | 0.72 | 0.79 | 0.87 | 0.54 | 0.55 | 1.46 | 1.58 | 1.08 | 0.83 | 0.77 | 0.99 | 0.90 | 0.72 |
| Dec-02 | 2003-2004 | 1.43 | 1.37 | 0.74 | 0.67 | 0.68 | 0.79 | 0.90 | 0.69 | 0.77 | 0.64 | 0.79 | 0.73 | 1.79 | 1.50 | 1.85 | 0.99 | 1.39 | 1.40 | 1.39 | 1.12 |
| Average | | 2.48 | 2.41 | 1.93 | 1.86 | 3.99 | 3.86 | 1.62 | 1.94 | 2.00 | 2.25 | 0.34 | 0.32 | 0.79 | 0.71 | 0.60 | 0.39 | 0.60 | 0.52 | 0.60 | 0.43 |

## Panel C: Small funds

| Forecast period : One year | | Attrition rate | | | | | Annual return of portfolio | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | SR_Year | Alpha_ Year | RC | Composite | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | | | | | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 14.4% | 8.3% | 0.0% | 4.2% | 0.0% | 14.69 | 18.68 | 18.53 | 23.44 | 24.30 | 27.56 | 16.68 | 22.98 | 26.13 | 27.24 |
| Dec-97 | 1998 | 17.8% | 12.5% | 12.5% | 8.7% | 0.0% | 10.15 | 12.77 | 17.58 | 18.54 | 10.27 | 17.63 | 18.89 | 24.20 | 14.77 | 14.72 |
| Dec-98 | 1999 | 13.7% | 0.0% | 0.0% | 25.0% | 0.0% | 26.65 | 29.60 | 33.07 | 50.30 | 42.70 | 55.04 | 18.47 | 23.12 | 36.68 | 38.52 |
| Dec-99 | 2000 | 20.5% | 16.7% | 8.3% | 12.5% | 0.0% | 8.95 | 10.21 | 10.21 | 8.42 | -2.26 | -9.80 | 17.88 | 15.28 | 9.72 | 9.25 |
| Dec-00 | 2001 | 22.6% | 0.0% | 4.2% | 20.8% | 4.2% | 5.44 | 6.65 | 11.46 | 7.91 | 8.58 | 5.60 | 8.64 | 8.52 | 14.11 | 12.15 |
| Dec-01 | 2002 | 21.2% | 12.5% | 8.3% | 12.5% | 0.0% | 2.38 | 2.45 | 8.52 | 8.63 | 12.45 | 8.89 | 2.46 | 3.17 | 6.88 | 2.88 |
| Dec-02 | 2003 | 14.7% | 12.5% | 12.5% | 8.3% | 0.0% | 23.38 | 23.57 | 14.84 | 13.61 | 24.85 | 32.28 | 16.75 | 14.29 | 15.88 | 18.58 |
| Average | | 17.8% | 8.9% | 6.5% | 13.1% | 0.6% | 13.09 | 14.85 | 16.32 | 18.69 | 17.27 | 19.60 | 14.25 | 15.94 | 17.74 | 17.62 |
| Forecast period : Two year | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 30.5% | 20.8% | 8.3% | 20.8% | 0.0% | 9.63 | 8.78 | 8.88 | 4.70 | 12.65 | 13.76 | 11.13 | 5.58 | 17.78 | 17.52 |
| Dec-97 | 1998-1999 | 28.3% | 16.7% | 20.8% | 21.7% | 0.0% | 16.66 | 19.63 | 19.33 | 21.53 | 12.21 | 18.38 | 21.02 | 23.61 | 21.85 | 23.83 |
| Dec-98 | 1999-2000 | 28.4% | 4.2% | 12.5% | 25.0% | 4.3% | 17.89 | 19.24 | 22.13 | 25.15 | 22.60 | 26.84 | 18.87 | 20.62 | 23.56 | 22.25 |
| Dec-99 | 2000-2001 | 35.1% | 25.0% | 20.8% | 25.0% | 0.0% | 7.72 | 8.12 | 8.28 | 4.07 | 6.25 | -0.43 | 10.98 | 9.35 | 7.74 | 8.17 |
| Dec-00 | 2001-2002 | 34.9% | 16.7% | 25.0% | 33.3% | 12.5% | 5.03 | 6.55 | 8.64 | 7.17 | 6.16 | 4.33 | 4.30 | 6.08 | 10.26 | 9.75 |
| Dec-01 | 2002-2003 | 30.2% | 20.8% | 12.5% | 29.2% | 8.3% | 13.16 | 12.65 | 16.52 | 13.96 | 19.04 | 15.10 | 10.79 | 9.27 | 13.61 | 9.89 |
| Dec-02 | 2003-2004 | 24.2% | 12.5% | 12.5% | 12.5% | 8.3% | 15.97 | 15.26 | 11.25 | 11.76 | 17.58 | 20.63 | 13.16 | 12.06 | 12.09 | 12.51 |
| Average | | 30.2% | 16.7% | 16.1% | 23.9% | 4.8% | 12.29 | 12.89 | 13.58 | 12.62 | 13.78 | 14.09 | 12.89 | 12.37 | 15.27 | 14.85 |

| Forecast period : One year | | Standard deviation of monthly return | | | | | | | | | | Mean return / standard deviation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | | SR_Year | | Alpha_Year | | RC | | Composite | | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 2.34 | 2.46 | 1.96 | 3.01 | 2.48 | 3.20 | 1.64 | 2.54 | 2.40 | 2.68 | 0.52 | 0.63 | 0.79 | 0.65 | 0.82 | 0.72 | 0.85 | 0.75 | 0.91 | 0.85 |
| Dec-97 | 1998 | 1.87 | 1.78 | 2.60 | 2.23 | 2.49 | 2.61 | 0.94 | 0.82 | 2.82 | 2.53 | 0.45 | 0.60 | 0.56 | 0.69 | 0.34 | 0.56 | 1.67 | 2.45 | 0.44 | 0.49 |
| Dec-98 | 1999 | 2.74 | 3.03 | 2.61 | 4.50 | 3.59 | 4.69 | 1.19 | 1.62 | 3.09 | 3.50 | 0.81 | 0.81 | 1.06 | 0.93 | 0.99 | 0.98 | 1.29 | 1.19 | 0.99 | 0.92 |
| Dec-99 | 2000 | 2.53 | 2.66 | 4.33 | 5.52 | 6.90 | 7.91 | 1.76 | 2.79 | 3.29 | 4.26 | 0.29 | 0.32 | 0.20 | 0.13 | -0.03 | -0.10 | 0.85 | 0.46 | 0.25 | 0.18 |
| Dec-00 | 2001 | 1.56 | 1.57 | 0.94 | 0.95 | 1.61 | 1.68 | 1.26 | 0.91 | 1.35 | 1.09 | 0.29 | 0.35 | 1.02 | 0.69 | 0.44 | 0.28 | 0.57 | 0.78 | 0.87 | 0.93 |
| Dec-01 | 2002 | 1.44 | 1.46 | 2.30 | 1.73 | 2.15 | 1.80 | 1.51 | 1.41 | 1.72 | 1.37 | 0.14 | 0.14 | 0.31 | 0.42 | 0.48 | 0.41 | 0.14 | 0.19 | 0.33 | 0.18 |
| Dec-02 | 2003 | 1.60 | 1.50 | 1.06 | 0.38 | 1.43 | 2.09 | 1.05 | 0.81 | 1.01 | 0.64 | 1.22 | 1.31 | 1.17 | 2.96 | 1.45 | 1.29 | 1.32 | 1.47 | 1.32 | 2.41 |
| Average | | 2.01 | 2.06 | 2.26 | 2.62 | 2.95 | 3.43 | 1.34 | 1.56 | 2.24 | 2.30 | 0.53 | 0.60 | 0.73 | 0.92 | 0.64 | 0.59 | 0.96 | 1.04 | 0.73 | 0.85 |
| Forecast period : Two year | | | | | | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 2.11 | 2.62 | 2.96 | 4.73 | 3.76 | 3.65 | 2.03 | 4.15 | 2.94 | 3.42 | 0.38 | 0.28 | 0.25 | 0.08 | 0.28 | 0.31 | 0.46 | 0.11 | 0.50 | 0.43 |
| Dec-97 | 1998-1999 | 1.89 | 1.77 | 2.28 | 1.96 | 3.03 | 2.88 | 1.17 | 1.09 | 2.78 | 2.38 | 0.73 | 0.92 | 0.71 | 0.92 | 0.34 | 0.53 | 1.50 | 1.81 | 0.65 | 0.84 |
| Dec-98 | 1999-2000 | 2.80 | 3.50 | 2.87 | 5.89 | 4.16 | 6.50 | 1.28 | 1.63 | 4.08 | 5.29 | 0.53 | 0.46 | 0.64 | 0.36 | 0.45 | 0.34 | 1.23 | 1.05 | 0.48 | 0.35 |
| Dec-99 | 2000-2001 | 2.11 | 2.27 | 3.57 | 4.48 | 5.85 | 6.52 | 1.84 | 2.14 | 3.49 | 5.34 | 0.31 | 0.30 | 0.19 | 0.08 | 0.09 | -0.01 | 0.50 | 0.36 | 0.18 | 0.13 |
| Dec-00 | 2001-2002 | 1.38 | 1.42 | 0.81 | 0.76 | 1.52 | 1.44 | 1.25 | 0.80 | 1.42 | 1.23 | 0.30 | 0.38 | 0.89 | 0.79 | 0.34 | 0.25 | 0.29 | 0.64 | 0.60 | 0.66 |
| Dec-01 | 2002-2003 | 1.76 | 1.71 | 2.00 | 1.43 | 1.88 | 1.59 | 1.55 | 1.31 | 2.05 | 1.72 | 0.63 | 0.62 | 0.69 | 0.82 | 0.84 | 0.79 | 0.58 | 0.59 | 0.55 | 0.48 |
| Dec-02 | 2003-2004 | 1.96 | 1.89 | 1.22 | 0.58 | 1.74 | 2.18 | 1.31 | 1.00 | 1.43 | 1.38 | 0.68 | 0.67 | 0.77 | 1.69 | 0.84 | 0.79 | 0.84 | 1.00 | 0.70 | 0.76 |
| Average | | 2.00 | 2.17 | 2.24 | 2.83 | 3.13 | 3.54 | 1.49 | 1.73 | 2.60 | 2.97 | 0.51 | 0.52 | 0.59 | 0.68 | 0.45 | 0.43 | 0.77 | 0.79 | 0.53 | 0.52 |

Table 22 Hazard ratios from the Cox PH model with time dependent covariates from 1994-2004
Panel A: ALL funds (Non-directional funds)

| Forecast period : One year | | Attrition rate | | | | | Annual return of portfolio | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | SR_Year | Alpha_ Year | RC | Composite | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | | | | | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 5.8% | 0.0% | 0.0% | 0.0% | 0.0% | 15.26 | 14.07 | 14.07 | 11.86 | 18.59 | 15.37 | 16.76 | 16.63 | 16.42 | 17.77 |
| Dec-97 | 1998 | 5.9% | 4.2% | 0.0% | 2.4% | 0.0% | 1.33 | -3.71 | 4.89 | -0.78 | 1.79 | -4.35 | 4.26 | -0.62 | -1.80 | -8.00 |
| Dec-98 | 1999 | 13.0% | 4.2% | 12.5% | 4.2% | 0.0% | 14.80 | 15.14 | 16.88 | 15.53 | 18.34 | 18.13 | 17.30 | 14.48 | 14.00 | 13.92 |
| Dec-99 | 2000 | 12.5% | 8.3% | 12.5% | 4.2% | 4.2% | 8.52 | 11.22 | 11.65 | 13.20 | 10.77 | 10.08 | 13.10 | 12.30 | 14.53 | 15.76 |
| Dec-00 | 2001 | 8.6% | 8.3% | 8.3% | 14.3% | 4.2% | 8.67 | 9.22 | 6.70 | 7.33 | 8.80 | 8.78 | 7.82 | 8.45 | 8.04 | 7.77 |
| Dec-01 | 2002 | 12.0% | 8.3% | 8.3% | 0.0% | 4.2% | 3.98 | 3.99 | 4.63 | 0.86 | 11.60 | 3.01 | 6.36 | 6.67 | 9.77 | 9.45 |
| Dec-02 | 2003 | 12.0% | 8.3% | 8.3% | 0.0% | 0.0% | 10.57 | 11.51 | 8.14 | 8.35 | 13.22 | 13.85 | 9.19 | 9.61 | 8.71 | 9.38 |
| Average | | 10.0% | 6.0% | 7.1% | 3.6% | 1.8% | 9.02 | 8.78 | 9.56 | 8.05 | 11.87 | 9.27 | 10.69 | 9.65 | 9.96 | 9.44 |
| Forecast period : Two year | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 10.8% | 16.7% | 4.2% | 6.5% | 0.0% | 8.35 | 5.23 | 4.36 | 3.01 | 8.06 | 1.08 | 9.20 | 8.52 | 8.76 | 5.55 |
| Dec-97 | 1998-1999 | 17.8% | 4.2% | 0.0% | 2.4% | 0.0% | 8.23 | 5.75 | 10.28 | 6.35 | 10.61 | 6.93 | 9.84 | 7.06 | 8.07 | 5.41 |
| Dec-98 | 1999-2000 | 23.1% | 8.3% | 25.0% | 8.3% | 8.3% | 11.18 | 13.06 | 12.48 | 13.76 | 11.77 | 15.84 | 14.33 | 12.44 | 12.28 | 14.97 |
| Dec-99 | 2000-2001 | 19.8% | 12.5% | 20.8% | 25.0% | 4.2% | 8.91 | 10.38 | 10.91 | 11.40 | 12.22 | 15.68 | 10.46 | 11.22 | 12.27 | 12.13 |
| Dec-00 | 2001-2002 | 20.2% | 12.5% | 12.5% | 17.1% | 4.2% | 6.08 | 6.47 | 5.34 | 5.41 | 6.83 | 4.86 | 6.24 | 6.72 | 5.83 | 5.04 |
| Dec-01 | 2002-2003 | 22.5% | 16.7% | 16.7% | 0.0% | 12.5% | 7.00 | 7.89 | 4.67 | 1.66 | 11.67 | 8.47 | 7.25 | 7.74 | 8.87 | 7.52 |
| Dec-02 | 2003-2004 | 19.9% | 8.3% | 8.3% | 12.5% | 8.3% | 8.08 | 9.12 | 8.50 | 8.49 | 10.22 | 10.76 | 9.23 | 9.61 | 7.17 | 7.93 |
| Average | | 19.2% | 11.3% | 12.5% | 10.3% | 5.4% | 8.26 | 8.27 | 8.08 | 7.15 | 10.20 | 9.09 | 9.51 | 9.04 | 9.04 | 8.36 |

| Forecast period : One year | | Standard deviation of monthly return | | | | | | | | | | Mean return / standard deviation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | | SR_Year | | Alpha_Year | | RC | | Composite | | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 0.63 | 0.65 | 0.35 | 0.64 | 0.98 | 1.04 | 0.23 | 0.21 | 0.50 | 0.79 | 2.03 | 1.82 | 3.32 | 1.55 | 1.58 | 1.23 | 6.18 | 6.53 | 2.72 | 1.88 |
| Dec-97 | 1998 | 1.97 | 2.20 | 1.51 | 1.95 | 2.37 | 3.58 | 1.23 | 1.54 | 2.70 | 3.41 | 0.06 | -0.14 | 0.27 | -0.03 | 0.06 | -0.10 | 0.29 | -0.03 | -0.06 | -0.20 |
| Dec-98 | 1999 | 0.81 | 0.51 | 0.63 | 0.42 | 1.05 | 0.67 | 0.69 | 0.35 | 0.34 | 0.47 | 1.52 | 2.47 | 2.24 | 3.09 | 1.46 | 2.25 | 2.10 | 3.45 | 3.44 | 2.47 |
| Dec-99 | 2000 | 0.95 | 0.57 | 0.16 | 0.42 | 1.17 | 0.82 | 0.88 | 0.68 | 0.62 | 0.55 | 0.75 | 1.64 | 5.91 | 2.62 | 0.77 | 1.03 | 1.24 | 1.50 | 1.96 | 2.37 |
| Dec-00 | 2001 | 0.73 | 0.56 | 0.63 | 0.71 | 0.67 | 1.23 | 0.32 | 0.43 | 0.66 | 0.88 | 0.98 | 1.38 | 0.88 | 0.86 | 1.10 | 0.60 | 2.01 | 1.62 | 1.02 | 0.73 |
| Dec-01 | 2002 | 0.65 | 0.74 | 1.80 | 2.29 | 0.90 | 2.28 | 0.11 | 0.29 | 0.39 | 0.37 | 0.51 | 0.45 | 0.21 | 0.03 | 1.07 | 0.11 | 4.65 | 1.93 | 2.11 | 2.12 |
| Dec-02 | 2003 | 0.54 | 0.55 | 0.46 | 0.56 | 1.01 | 1.06 | 0.13 | 0.29 | 0.84 | 0.93 | 1.62 | 1.74 | 1.47 | 1.25 | 1.09 | 1.09 | 5.70 | 2.79 | 0.86 | 0.84 |
| Average | | 0.90 | 0.82 | 0.79 | 1.00 | 1.16 | 1.53 | 0.51 | 0.54 | 0.86 | 1.06 | 1.07 | 1.34 | 2.04 | 1.34 | 1.02 | 0.89 | 3.17 | 2.54 | 1.72 | 1.46 |
| Forecast period : Two year | | | | | | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 1.52 | 1.78 | 1.76 | 1.96 | 2.42 | 3.16 | 1.10 | 1.14 | 1.61 | 2.61 | 0.46 | 0.24 | 0.21 | 0.13 | 0.28 | 0.03 | 0.70 | 0.62 | 0.45 | 0.18 |
| Dec-97 | 1998-1999 | 1.58 | 1.76 | 1.16 | 1.50 | 1.88 | 2.68 | 1.03 | 1.27 | 2.16 | 2.70 | 0.43 | 0.27 | 0.74 | 0.35 | 0.47 | 0.22 | 0.79 | 0.46 | 0.31 | 0.17 |
| Dec-98 | 1999-2000 | 0.98 | 0.55 | 1.07 | 0.69 | 1.37 | 0.84 | 0.89 | 0.50 | 0.51 | 0.47 | 0.95 | 1.98 | 0.97 | 1.67 | 0.72 | 1.57 | 1.33 | 2.08 | 2.01 | 2.65 |
| Dec-99 | 2000-2001 | 0.85 | 0.57 | 0.52 | 0.44 | 1.10 | 0.94 | 0.72 | 0.56 | 0.78 | 0.89 | 0.87 | 1.51 | 1.77 | 2.17 | 0.93 | 1.38 | 1.22 | 1.66 | 1.31 | 1.13 |
| Dec-00 | 2001-2002 | 0.74 | 0.68 | 0.55 | 0.72 | 0.61 | 1.47 | 0.28 | 0.40 | 0.64 | 0.88 | 0.69 | 0.79 | 0.81 | 0.62 | 0.93 | 0.28 | 1.89 | 1.40 | 0.76 | 0.48 |
| Dec-01 | 2002-2003 | 0.65 | 0.71 | 1.29 | 1.67 | 0.85 | 1.88 | 0.16 | 0.31 | 0.38 | 0.53 | 0.90 | 0.92 | 0.30 | 0.08 | 1.15 | 0.38 | 3.87 | 2.05 | 1.92 | 1.18 |
| Dec-02 | 2003-2004 | 0.61 | 0.62 | 0.38 | 0.47 | 0.86 | 0.92 | 0.31 | 0.33 | 0.74 | 0.78 | 1.11 | 1.23 | 1.85 | 1.50 | 1.00 | 0.97 | 2.46 | 2.41 | 0.81 | 0.85 |
| Average | | 0.99 | 0.95 | 0.96 | 1.06 | 1.30 | 1.70 | 0.64 | 0.65 | 0.97 | 1.27 | 0.77 | 0.99 | 0.95 | 0.93 | 0.78 | 0.69 | 1.75 | 1.53 | 1.08 | 0.95 |

## Panel B: Large funds

| Forecast period : One year | | Attrition rate | | | | | Annual return of portfolio | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | SR_Year | Alpha_ Year | RC | Composite | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | | | | | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 2.38% | 0.0% | 0.0% | 0.0% | 0.0% | 14.67 | 14.10 | 16.15 | 14.94 | 17.45 | 15.47 | 15.24 | 15.10 | 15.03 | 16.32 |
| Dec-97 | 1998 | 7.32% | 4.2% | 0.0% | 4.2% | 0.0% | -1.89 | -5.24 | 2.19 | -1.32 | -2.66 | -3.43 | 0.34 | -2.73 | -4.74 | -8.32 |
| Dec-98 | 1999 | 6.12% | 4.2% | 4.2% | 12.5% | 0.0% | 13.30 | 14.92 | 16.50 | 15.32 | 16.06 | 16.00 | 13.64 | 13.52 | 12.52 | 13.28 |
| Dec-99 | 2000 | 7.14% | 4.2% | 4.2% | 4.2% | 8.3% | 9.03 | 11.18 | 13.27 | 14.35 | 11.76 | 13.29 | 10.64 | 13.55 | 7.88 | 10.60 |
| Dec-00 | 2001 | 5.59% | 4.2% | 4.2% | 16.7% | 0.0% | 7.96 | 9.33 | 8.79 | 8.17 | 6.70 | 7.45 | 7.08 | 7.50 | 9.52 | 8.72 |
| Dec-01 | 2002 | 7.03% | 4.2% | 8.3% | 4.2% | 0.0% | 3.90 | 3.95 | 4.71 | -1.62 | 7.07 | 0.18 | 6.88 | 6.95 | 5.59 | 4.46 |
| Dec-02 | 2003 | 7.18% | 16.7% | 8.3% | 4.3% | 4.2% | 9.54 | 11.52 | 4.72 | 3.92 | 11.98 | 12.63 | 12.34 | 11.28 | 9.05 | 7.93 |
| Average | | 6.1% | 5.4% | 4.2% | 6.6% | 1.8% | 8.07 | 8.54 | 9.48 | 7.68 | 9.77 | 8.80 | 9.45 | 9.31 | 7.84 | 7.57 |
| Forecast period : Two year | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 7.1% | 8.3% | 4.2% | 4.2% | 0.0% | 7.32 | 4.69 | 7.97 | 4.51 | 8.83 | 5.13 | 8.22 | 4.77 | 8.25 | 4.69 |
| Dec-97 | 1998-1999 | 19.5% | 4.2% | 8.3% | 4.2% | 0.0% | 6.11 | 5.08 | 7.48 | 5.44 | 8.27 | 7.47 | 7.50 | 5.67 | 5.21 | 4.32 |
| Dec-98 | 1999-2000 | 16.3% | 12.5% | 16.7% | 16.7% | 8.3% | 11.35 | 13.05 | 14.33 | 13.28 | 13.52 | 14.20 | 11.83 | 12.63 | 12.32 | 14.42 |
| Dec-99 | 2000-2001 | 11.6% | 12.5% | 8.3% | 12.5% | 4.2% | 8.85 | 10.46 | 11.50 | 12.02 | 11.69 | 13.41 | 8.86 | 11.05 | 9.17 | 11.60 |
| Dec-00 | 2001-2002 | 12.6% | 8.3% | 4.2% | 16.7% | 4.2% | 5.55 | 6.43 | 5.91 | 4.44 | 4.86 | 5.04 | 4.93 | 5.69 | 6.72 | 5.68 |
| Dec-01 | 2002-2003 | 16.8% | 16.7% | 20.8% | 4.2% | 12.5% | 6.45 | 7.84 | 5.58 | 2.34 | 6.49 | 3.28 | 6.36 | 7.61 | 6.32 | 7.52 |
| Dec-02 | 2003-2004 | 17.2% | 20.8% | 8.3% | 17.4% | 8.3% | 7.40 | 9.13 | 6.11 | 5.42 | 8.84 | 9.22 | 9.55 | 9.01 | 7.35 | 7.02 |
| Average | | 14.5% | 11.9% | 10.1% | 10.8% | 5.4% | 7.58 | 8.10 | 8.41 | 6.78 | 8.93 | 8.25 | 8.18 | 8.06 | 7.91 | 7.89 |

| Forecast period : One year | | Standard deviation of monthly return | | | | | | | | | | Mean return / standard deviation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | | SR_Year | | Alpha_Year | | RC | | Composite | | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 0.68 | 0.72 | 0.42 | 0.66 | 0.90 | 0.96 | 0.68 | 0.69 | 0.97 | 0.89 | 1.79 | 1.63 | 3.23 | 1.88 | 1.61 | 1.35 | 1.87 | 1.83 | 1.29 | 1.53 |
| Dec-97 | 1998 | 1.90 | 2.31 | 1.58 | 1.82 | 2.73 | 2.92 | 1.73 | 2.17 | 2.55 | 3.27 | -0.08 | -0.19 | 0.12 | -0.06 | -0.08 | -0.10 | 0.02 | -0.10 | -0.15 | -0.21 |
| Dec-98 | 1999 | 0.44 | 0.48 | 0.29 | 0.33 | 0.45 | 0.50 | 0.27 | 0.39 | 0.61 | 0.52 | 2.51 | 2.59 | 4.78 | 3.84 | 2.96 | 2.64 | 4.17 | 2.91 | 1.70 | 2.11 |
| Dec-99 | 2000 | 0.63 | 0.53 | 0.46 | 0.52 | 1.12 | 0.87 | 0.81 | 0.63 | 0.62 | 0.53 | 1.20 | 1.77 | 2.39 | 2.31 | 0.87 | 1.28 | 1.10 | 1.78 | 1.06 | 1.68 |
| Dec-00 | 2001 | 0.60 | 0.57 | 0.63 | 0.87 | 0.87 | 1.03 | 0.65 | 0.66 | 0.59 | 0.87 | 1.11 | 1.36 | 1.15 | 0.78 | 0.64 | 0.60 | 0.90 | 0.95 | 1.34 | 0.84 |
| Dec-01 | 2002 | 0.54 | 0.73 | 0.94 | 1.75 | 0.93 | 1.75 | 0.35 | 0.41 | 0.68 | 1.22 | 0.60 | 0.45 | 0.42 | -0.08 | 0.63 | 0.01 | 1.66 | 1.43 | 0.69 | 0.31 |
| Dec-02 | 2003 | 0.51 | 0.55 | 0.64 | 0.67 | 0.97 | 1.04 | 0.79 | 0.86 | 0.76 | 0.83 | 1.57 | 1.76 | 0.61 | 0.49 | 1.03 | 1.01 | 1.30 | 1.10 | 0.99 | 0.80 |
| Average | | 0.76 | 0.84 | 0.71 | 0.95 | 1.14 | 1.30 | 0.75 | 0.83 | 0.97 | 1.16 | 1.24 | 1.34 | 1.81 | 1.31 | 1.09 | 0.97 | 1.58 | 1.41 | 0.99 | 1.01 |
| Forecast period : Two year | | | | | | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 1.51 | 1.90 | 1.48 | 2.09 | 1.81 | 2.37 | 1.53 | 2.08 | 1.85 | 2.65 | 0.40 | 0.21 | 0.45 | 0.18 | 0.41 | 0.18 | 0.45 | 0.19 | 0.37 | 0.15 |
| Dec-97 | 1998-1999 | 1.51 | 1.86 | 1.20 | 1.41 | 2.13 | 2.26 | 1.38 | 1.70 | 1.99 | 2.55 | 0.34 | 0.23 | 0.52 | 0.32 | 0.32 | 0.28 | 0.45 | 0.28 | 0.22 | 0.14 |
| Dec-98 | 1999-2000 | 0.54 | 0.49 | 0.43 | 0.38 | 0.65 | 0.61 | 0.41 | 0.43 | 0.76 | 0.62 | 1.75 | 2.22 | 2.80 | 2.88 | 1.72 | 1.95 | 2.40 | 2.44 | 1.36 | 1.93 |
| Dec-99 | 2000-2001 | 0.58 | 0.54 | 0.41 | 0.46 | 0.89 | 0.72 | 0.80 | 0.75 | 0.83 | 0.80 | 1.27 | 1.60 | 2.33 | 2.15 | 1.09 | 1.56 | 0.92 | 1.23 | 0.93 | 1.20 |
| Dec-00 | 2001-2002 | 0.62 | 0.70 | 0.68 | 1.18 | 0.75 | 1.08 | 0.65 | 0.61 | 0.65 | 0.96 | 0.74 | 0.76 | 0.72 | 0.31 | 0.54 | 0.39 | 0.63 | 0.77 | 0.86 | 0.49 |
| Dec-01 | 2002-2003 | 0.53 | 0.71 | 0.78 | 1.42 | 0.90 | 1.45 | 0.36 | 0.48 | 0.55 | 0.96 | 1.01 | 0.92 | 0.59 | 0.14 | 0.60 | 0.19 | 1.49 | 1.32 | 0.96 | 0.66 |
| Dec-02 | 2003-2004 | 0.54 | 0.61 | 0.52 | 0.55 | 0.85 | 0.93 | 0.80 | 0.79 | 0.68 | 0.70 | 1.14 | 1.24 | 0.98 | 0.82 | 0.86 | 0.83 | 1.00 | 0.95 | 0.90 | 0.83 |
| Average | | 0.83 | 0.97 | 0.79 | 1.07 | 1.14 | 1.34 | 0.85 | 0.98 | 1.04 | 1.32 | 0.95 | 1.03 | 1.20 | 0.97 | 0.79 | 0.77 | 1.05 | 1.03 | 0.80 | 0.77 |

## Panel C: Small funds

| Forecast period : One year | | Attrition rate | | | | | Annual return of portfolio | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | SR_Year | Alpha_ Year | RC | Composite | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | | | | | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 7.7% | 0.0% | 0.0% | 0.0% | 0.0% | 15.61 | 13.76 | 14.73 | 13.29 | 17.76 | 16.01 | 14.61 | 13.69 | 17.74 | 16.97 |
| Dec-97 | 1998 | 4.6% | 0.0% | 0.0% | 0.0% | 0.0% | 4.31 | 6.97 | 9.80 | 9.90 | 9.83 | 10.57 | 8.75 | 10.34 | 8.14 | 7.76 |
| Dec-98 | 1999 | 18.6% | 4.2% | 16.7% | 4.2% | 0.0% | 16.16 | 16.37 | 15.73 | 15.95 | 16.71 | 20.88 | 16.66 | 20.60 | 13.12 | 11.94 |
| Dec-99 | 2000 | 16.6% | 12.5% | 8.3% | 0.0% | 0.0% | 8.08 | 11.55 | 14.38 | 12.70 | 14.44 | 17.45 | 14.46 | 16.29 | 12.96 | 15.23 |
| Dec-00 | 2001 | 11.3% | 8.3% | 8.3% | 8.3% | 4.2% | 9.32 | 8.08 | 8.14 | 8.26 | 9.56 | 10.60 | 7.46 | 7.86 | 7.91 | 7.70 |
| Dec-01 | 2002 | 18.2% | 8.3% | 4.2% | 8.3% | 4.2% | 4.08 | 4.57 | 7.93 | 8.70 | 15.93 | 14.84 | 4.49 | 3.26 | 10.38 | 11.24 |
| Dec-02 | 2003 | 17.5% | 8.3% | 12.5% | 4.2% | 8.3% | 11.79 | 11.44 | 8.53 | 9.32 | 16.50 | 20.69 | 10.13 | 10.36 | 7.58 | 8.14 |
| Average | | 13.5% | 6.0% | 7.1% | 3.6% | 2.4% | 9.91 | 10.39 | 11.32 | 11.16 | 14.39 | 15.86 | 10.94 | 11.77 | 11.12 | 11.28 |
| Forecast period : Two year | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 12.8% | 8.3% | 12.5% | 13.6% | 0.0% | 8.96 | 6.76 | 5.76 | 3.83 | 8.65 | 4.95 | 9.15 | 8.01 | 11.56 | 11.29 |
| Dec-97 | 1998-1999 | 16.1% | 0.0% | 0.0% | 4.2% | 0.0% | 10.18 | 10.59 | 13.34 | 12.70 | 14.32 | 13.81 | 13.29 | 13.31 | 11.71 | 11.27 |
| Dec-98 | 1999-2000 | 28.8% | 12.5% | 25.0% | 4.2% | 4.3% | 11.02 | 13.20 | 13.04 | 12.93 | 10.24 | 13.25 | 11.83 | 13.77 | 11.93 | 12.40 |
| Dec-99 | 2000-2001 | 26.2% | 20.8% | 16.7% | 12.5% | 0.0% | 8.96 | 9.83 | 12.36 | 11.77 | 12.01 | 14.14 | 12.36 | 12.64 | 11.98 | 12.19 |
| Dec-00 | 2001-2002 | 27.0% | 16.7% | 16.7% | 12.5% | 12.5% | 6.56 | 6.53 | 6.88 | 6.43 | 7.88 | 8.22 | 5.12 | 5.47 | 5.35 | 5.51 |
| Dec-01 | 2002-2003 | 29.7% | 8.3% | 4.2% | 12.5% | 8.3% | 7.77 | 8.67 | 8.98 | 9.09 | 16.11 | 15.39 | 8.17 | 8.03 | 9.80 | 10.73 |
| Dec-02 | 2003-2004 | 23.0% | 16.7% | 12.5% | 4.2% | 8.3% | 8.90 | 8.98 | 9.14 | 8.04 | 11.93 | 13.16 | 8.79 | 8.63 | 6.71 | 7.58 |
| Average | | 23.4% | 11.9% | 12.5% | 9.1% | 4.8% | 8.91 | 9.22 | 9.93 | 9.26 | 11.59 | 11.85 | 9.82 | 9.98 | 9.86 | 10.14 |

| Forecast period : One year | | Standard deviation of monthly return | | | | | | | | | | Mean return / standard deviation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In the smaple | Out of sample | All | | SR_Year | | Alpha_Year | | RC | | Composite | | All | | SR_Year | | Alpha_Year | | RC | | Composite | |
| | | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW | EW | VW |
| Dec-96 | 1997 | 0.66 | 0.50 | 0.36 | 0.43 | 0.65 | 0.43 | 0.47 | 0.34 | 2.15 | 1.58 | 1.97 | 2.27 | 3.42 | 2.61 | 2.29 | 3.12 | 2.59 | 3.32 | 0.69 | 0.90 |
| Dec-97 | 1998 | 2.18 | 1.64 | 1.34 | 0.95 | 1.74 | 1.59 | 1.84 | 1.33 | 0.55 | 0.56 | 0.16 | 0.36 | 0.61 | 0.87 | 0.47 | 0.55 | 0.40 | 0.65 | 1.23 | 1.15 |
| Dec-98 | 1999 | 1.23 | 0.99 | 1.13 | 1.09 | 1.12 | 1.67 | 1.02 | 1.54 | 1.01 | 0.80 | 1.09 | 1.37 | 1.16 | 1.22 | 1.24 | 1.04 | 1.36 | 1.12 | 1.09 | 1.25 |
| Dec-99 | 2000 | 1.26 | 0.96 | 0.46 | 0.32 | 1.38 | 1.30 | 0.81 | 1.02 | 0.71 | 0.67 | 0.53 | 1.01 | 2.63 | 3.29 | 0.87 | 1.12 | 1.49 | 1.32 | 1.52 | 1.89 |
| Dec-00 | 2001 | 0.90 | 0.52 | 0.55 | 0.56 | 0.61 | 0.58 | 0.86 | 0.73 | 0.59 | 0.72 | 0.86 | 1.29 | 1.23 | 1.23 | 1.31 | 1.53 | 0.73 | 0.90 | 1.11 | 0.89 |
| Dec-01 | 2002 | 0.82 | 0.86 | 1.00 | 0.81 | 1.35 | 1.24 | 0.77 | 0.79 | 0.58 | 0.72 | 0.42 | 0.45 | 0.66 | 0.90 | 0.98 | 1.00 | 0.49 | 0.34 | 1.48 | 1.31 |
| Dec-02 | 2003 | 0.62 | 0.67 | 0.42 | 0.44 | 1.10 | 1.51 | 0.57 | 0.64 | 0.89 | 0.81 | 1.58 | 1.42 | 1.70 | 1.75 | 1.25 | 1.14 | 1.47 | 1.36 | 0.71 | 0.84 |
| Average | | 1.10 | 0.88 | 0.75 | 0.66 | 1.14 | 1.19 | 0.91 | 0.91 | 0.93 | 0.84 | 0.95 | 1.17 | 1.63 | 1.70 | 1.20 | 1.36 | 1.22 | 1.29 | 1.12 | 1.17 |
| Forecast period : Two year | | | | | | | | | | | | | | | | | | | | | |
| Dec-96 | 1997-1998 | 1.61 | 1.52 | 1.68 | 2.12 | 2.08 | 1.88 | 1.43 | 1.35 | 1.93 | 1.34 | 0.46 | 0.37 | 0.29 | 0.15 | 0.35 | 0.22 | 0.53 | 0.50 | 0.50 | 0.70 |
| Dec-97 | 1998-1999 | 1.79 | 1.27 | 1.12 | 0.83 | 1.51 | 1.23 | 1.48 | 1.08 | 0.65 | 0.49 | 0.47 | 0.69 | 1.00 | 1.28 | 0.79 | 0.94 | 0.75 | 1.03 | 1.51 | 1.92 |
| Dec-98 | 1999-2000 | 1.49 | 1.11 | 1.39 | 1.23 | 1.47 | 2.04 | 1.33 | 2.02 | 1.16 | 0.92 | 0.62 | 0.99 | 0.78 | 0.88 | 0.58 | 0.54 | 0.74 | 0.57 | 0.85 | 1.12 |
| Dec-99 | 2000-2001 | 1.16 | 0.87 | 0.70 | 0.36 | 1.45 | 1.11 | 0.83 | 0.96 | 0.76 | 0.80 | 0.65 | 0.94 | 1.47 | 2.69 | 0.69 | 1.06 | 1.23 | 1.10 | 1.31 | 1.28 |
| Dec-00 | 2001-2002 | 0.89 | 0.59 | 0.45 | 0.48 | 0.53 | 0.53 | 0.88 | 0.84 | 0.55 | 0.71 | 0.61 | 0.93 | 1.26 | 1.12 | 1.25 | 1.29 | 0.48 | 0.54 | 0.82 | 0.65 |
| Dec-01 | 2002-2003 | 0.86 | 0.89 | 0.86 | 0.78 | 1.24 | 1.16 | 0.67 | 0.73 | 0.56 | 0.68 | 0.76 | 0.81 | 0.87 | 0.98 | 1.08 | 1.11 | 1.02 | 0.92 | 1.45 | 1.31 |
| Dec-02 | 2003-2004 | 0.71 | 0.70 | 0.43 | 0.47 | 1.06 | 1.39 | 0.63 | 0.64 | 1.05 | 0.90 | 1.04 | 1.07 | 1.78 | 1.43 | 0.94 | 0.79 | 1.16 | 1.12 | 0.53 | 0.71 |
| Average | | 1.21 | 0.99 | 0.95 | 0.90 | 1.33 | 1.33 | 1.04 | 1.09 | 0.95 | 0.83 | 0.66 | 0.83 | 1.06 | 1.22 | 0.81 | 0.85 | 0.85 | 0.82 | 1.00 | 1.10 |

Appendix:

Table A1 Test results about the mean difference of performance and risk between mutual groups

Panel A: directional funds

| | Live funds of Group1 for directional style | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | vs. Live funds of Group2 | | | | | | vs. Live funds of Group3 | | | | | | vs. Defunct funds of Group1 | | | | | |
| Variables | Mean--Group1 | Mean--Group2 | DIF | T value | P_value | | Mean--Group1 | Mean--Group3 | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| Average monthly return | 1.43 | 1.21 | 0.21 | 2.58 | 0.01 | ** | 1.43 | 1.03 | 0.40 | 5.05 | <.0001 | *** | 1.51 | 1.43 | 0.09 | 0.63 | 0.53 | |
| Average monthly excess return | 0.51 | 0.30 | 0.20 | 2.48 | 0.01 | ** | 0.51 | 0.21 | 0.29 | 3.74 | 0.00 | *** | 0.49 | 0.51 | -0.02 | -0.15 | 0.88 | |
| Volatility of monthly return | 4.85 | 5.62 | -0.77 | -2.16 | 0.03 | ** | 4.85 | 6.57 | -1.72 | -4.43 | <.0001 | *** | 5.67 | 4.85 | 0.82 | 1.89 | 0.06 | * |
| Volatility of monthly excess return | 4.63 | 5.19 | -0.56 | -1.98 | 0.05 | ** | 4.63 | 6.09 | -1.46 | -4.41 | <.0001 | *** | 5.27 | 4.63 | 0.64 | 1.85 | 0.07 | * |
| Jensen alpha (Alpha1) | 0.75 | 0.47 | 0.29 | 4.02 | <.0001 | *** | 0.75 | 0.36 | 0.40 | 4.97 | <.0001 | *** | 0.64 | 0.75 | -0.12 | -0.96 | 0.34 | |
| Alpha2 | 0.68 | 0.25 | 0.43 | 3.41 | 0.00 | *** | 0.68 | 0.25 | 0.43 | 3.68 | 0.00 | *** | 0.46 | 0.68 | -0.22 | -1.51 | 0.13 | |
| Beta | 0.65 | 0.78 | -0.13 | -1.81 | 0.07 | * | 0.65 | 0.80 | -0.16 | -2.11 | 0.04 | ** | 0.75 | 0.65 | 0.10 | 1.07 | 0.29 | |
| Beta1 | 0.67 | 0.86 | -0.19 | -2.00 | 0.05 | ** | 0.67 | 0.87 | -0.19 | -2.41 | 0.02 | ** | 0.81 | 0.67 | 0.14 | 1.38 | 0.17 | |
| Beta2 | 0.08 | 0.24 | -0.16 | -1.59 | 0.11 | | 0.08 | 0.17 | -0.10 | -0.94 | 0.35 | | 0.16 | 0.08 | 0.09 | 0.82 | 0.41 | |
| Maximal monthly loss | -13.42 | -13.88 | 0.46 | 0.44 | 0.66 | | -13.42 | -18.00 | 4.58 | 3.16 | 0.00 | *** | -12.34 | -13.42 | 1.08 | 0.85 | 0.40 | |
| Maximal monthly excess loss | -13.03 | -14.48 | 1.43 | 1.76 | 0.08 | * | -13.03 | -17.29 | 1.43 | 3.99 | <.0001 | *** | -12.15 | -13.03 | 0.88 | 0.8 | 0.42 | |
| Maximal drawdown | -14.90 | -18.10 | 3.20 | 2.56 | 0.01 | ** | -14.90 | -20.30 | 5.41 | 4.11 | <.0001 | *** | -16.00 | -14.90 | -1.10 | -0.650 | 0.52 | |
| Average drawdown | -5.30 | -7.70 | 2.47 | 4.08 | <.0001 | *** | -5.30 | -8.80 | 3.52 | 5.51 | <.0001 | *** | -6.90 | -5.30 | -1.60 | -2.410 | 0.02 | ** |
| proportion of recovering maximal loss | 0.90 | 0.79 | 0.107 | 2.43 | 0.02 | ** | 0.90 | 0.711 | 0.190 | 4.15 | <.0001 | *** | 0.45 | 0.90 | -0.446 | -6.890 | <.0001 | *** |
| proportion of recovering maximal drawdown | 0.88 | 0.77 | 0.109 | 2.34 | 0.02 | ** | 0.88 | 0.711 | 0.164 | 3.51 | 0.00 | *** | 0.53 | 0.88 | -0.345 | -5.250 | <.0001 | *** |
| proportion of recovering average drawdown | 1.00 | 0.97 | 0.028 | 1.75 | 0.08 | * | 1.00 | 0.967 | 0.033 | 2.03 | 0.05 | ** | 0.97 | 1.00 | -0.030 | -1.430 | 0.16 | |
| Recovery rate | 0.76 | 0.64 | 0.117 | 4.47 | <.0001 | *** | 0.76 | 0.626 | 0.133 | 4.92 | <.0001 | *** | 0.67 | 0.76 | -0.089 | -3.250 | 0.00 | *** |
| Relative Recovery rate | 0.72 | 0.58 | 0.133 | 4.47 | <.0001 | *** | 0.72 | 0.549 | 0.167 | 5.62 | <.0001 | *** | 0.64 | 0.72 | -0.079 | -2.520 | 0.01 | ** |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

| Variables | Live funds of Group2 for directional style | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | vs. Live funds of Group3 | | | | | | vs. Defunct funds of Group2 | | | | | |
| | Mean--Group2 | Mean--Group3 | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| Average monthly return | 1.21 | 1.03 | 0.18 | 1.96 | 0.05 | * | 1.30 | 1.21 | 0.08 | 0.62 | 0.54 | |
| Average monthly excess return | 0.30 | 0.21 | 0.09 | 0.96 | 0.34 | | 0.31 | 0.30 | 0.01 | 0.05 | 0.96 | |
| Volatility of monthly return | 5.62 | 6.57 | -0.95 | -2.19 | 0.03 | ** | 6.27 | 5.62 | 0.66 | 1.36 | 0.17 | |
| Volatility of monthly excess return | 5.19 | 6.09 | -0.90 | -2.44 | 0.02 | ** | 5.89 | 5.19 | 0.70 | 1.72 | 0.09 | * |
| Jensen alpha (Alpha1) | 0.47 | 0.36 | 0.11 | 1.23 | 0.22 | | 0.42 | 0.47 | -0.05 | -0.37 | 0.71 | |
| Alpha2 | 0.25 | 0.25 | 0.00 | 0.03 | 0.98 | | 0.49 | 0.25 | 0.23 | 1.13 | 0.26 | |
| Beta | 0.78 | 0.80 | -0.03 | -0.30 | 0.76 | | 0.74 | 0.78 | -0.04 | -0.35 | 0.73 | |
| Beta1 | 0.86 | 0.87 | -0.01 | -0.06 | 0.95 | | 0.72 | 0.86 | -0.14 | -1.12 | 0.26 | |
| Beta2 | 0.24 | 0.17 | 0.06 | 0.50 | 0.62 | | 0.00 | 0.24 | -0.24 | -1.66 | 0.10 | * |
| Maximal monthly loss | -13.88 | -18.00 | 4.11 | 2.91 | 0.00 | *** | -15.90 | -13.88 | -2.02 | -1.41 | 0.16 | |
| Maximal monthly excess loss | -14.48 | -17.29 | 2.82 | 2.50 | 0.01 | ** | -14.83 | -14.48 | -0.35 | -0.31 | 0.76 | |
| Maximal drawdown | -18.10 | -20.30 | 2.21 | 1.41 | 0.16 | | -16.50 | -18.10 | 1.56 | 0.94 | 0.35 | |
| Average drawdown | -7.70 | -8.80 | 1.05 | 1.27 | 0.21 | | -7.20 | -7.70 | 0.54 | 0.59 | 0.56 | |
| proportion of recovering maximal loss | 0.79 | 0.71 | 0.08 | 1.46 | 0.15 | | 0.41 | 0.79 | -0.38 | -6.09 | <.0001 | *** |
| proportion of recovering maximal drawdown | 0.77 | 0.71 | 0.06 | 0.95 | 0.34 | | 0.48 | 0.77 | -0.29 | -4.41 | <.0001 | *** |
| proportion of recovering average drawdown | 0.97 | 0.97 | 0.01 | 0.22 | 0.83 | | 0.97 | 0.97 | 0.00 | -0.08 | 0.9334 | |
| Recovery rate | 0.64 | 0.63 | 0.02 | 0.50 | 0.62 | | 0.62 | 0.64 | -0.03 | -0.77 | 0.4412 | |
| Relative Recovery rate | 0.58 | 0.55 | 0.03 | 0.95 | 0.34 | | 0.59 | 0.58 | 0.00 | 0.12 | 0.904 | |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

| Variables | Live funds of Group3 for directional style | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | vs. Defunct funds of Group2 | | | | | | vs. Defunct funds of Group3 | | | | | |
| | Defunct | Live | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| Average monthly return | 1.30 | 1.03 | 0.27 | 2.04 | 0.04 | ** | 0.51 | 1.03 | -0.52 | -4.89 | <.0001 | *** |
| Average monthly excess return | 0.31 | 0.21 | 0.10 | 0.74 | 0.46 | | -0.43 | 0.21 | -0.64 | -6.01 | <.0001 | *** |
| Volatility of monthly return | 6.27 | 6.57 | -0.30 | -0.58 | 0.56 | | 7.04 | 6.57 | 0.47 | 1.12 | 0.27 | |
| Volatility of monthly excess return | 5.89 | 6.09 | -0.20 | -0.46 | 0.65 | | 6.90 | 6.09 | 0.81 | 2.21 | 0.03 | ** |
| Jensen alpha (Alpha1) | 0.42 | 0.36 | 0.06 | 0.43 | 0.67 | | -0.37 | 0.36 | -0.73 | -6.76 | <.0001 | *** |
| Alpha2 | 0.49 | 0.25 | 0.24 | 1.19 | 0.24 | | -0.37 | 0.25 | -0.62 | -4.12 | <.0001 | *** |
| Beta | 0.74 | 0.80 | -0.06 | -0.63 | 0.53 | | 0.71 | 0.80 | -0.09 | -1.22 | 0.22 | |
| Beta1 | 0.72 | 0.87 | -0.15 | -1.24 | 0.22 | | 0.70 | 0.87 | -0.17 | -1.89 | 0.06 | * |
| Beta2 | 0.00 | 0.17 | -0.18 | -1.22 | 0.22 | | 0.01 | 0.17 | -0.16 | -1.29 | 0.20 | |
| Maximal monthly loss | -15.90 | -18.00 | 2.10 | 1.19 | 0.23 | | -16.99 | -18.00 | 1.01 | 0.70 | 0.49 | |
| Maximal monthly excess loss | -14.83 | -17.29 | 2.46 | 1.85 | 0.07 | * | -17.12 | -17.29 | 0.17 | 0.16 | 0.87 | |
| Maximal drawdown | -16.50 | -20.30 | 3.78 | 2.23 | 0.03 | ** | -19.40 | -20.30 | 0.90 | 0.67 | 0.50 | |
| Average drawdown | -7.20 | -8.80 | 1.59 | 1.69 | 0.09 | * | -9.10 | -8.80 | -0.30 | -0.47 | 0.64 | |
| proportion of recovering maximal loss | 0.41 | 0.71 | -0.30 | -4.70 | <.0001 | *** | 0.35 | 0.71 | -0.36 | -7.52 | <.0001 | *** |
| proportion of recovering maximal drawdown | 0.48 | 0.71 | -0.23 | -3.58 | 0.00 | *** | 0.41 | 0.71 | -0.31 | -6.21 | <.0001 | *** |
| proportion of recovering average drawdown | 0.97 | 0.97 | 0.00 | 0.13 | 0.90 | | 0.93 | 0.97 | -0.04 | -1.95 | 0.05 | * |
| Recovery rate | 0.62 | 0.63 | -0.01 | -0.25 | 0.80 | | 0.49 | 0.63 | -0.13 | -5.22 | <.0001 | *** |
| Relative Recovery rate | 0.59 | 0.55 | 0.04 | 1.11 | 0.27 | | 0.45 | 0.55 | -0.10 | -3.66 | 0.00 | *** |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Panel B: Non-directional funds

| | Live funds of Group1 for nondirectional style | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | vs. Live funds of Group2 | | | | | | vs. Live funds of Group3 | | | | | | vs. Defunct funds of Group1 | | | | | |
| Variables | Mean--Group1 | Mean--Group2 | DIF | T value | P_value | | Mean--Group1 | Mean--Group3 | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| Average monthly return | 0.99 | 0.97 | 0.02 | 0.23 | 0.82 | | 0.99 | 0.81 | 0.17 | 2.74 | 0.01 | *** | 1.14 | 0.99 | 0.15 | 0.79 | 0.43 | |
| Average monthly excess return | 0.20 | 0.14 | 0.05 | 0.71 | 0.48 | | 0.20 | -0.02 | 0.22 | 3.33 | 0.00 | *** | 0.30 | 0.20 | 0.11 | 0.64 | 0.53 | |
| Volatility of monthly return | 1.81 | 2.59 | -0.79 | -2.11 | 0.04 | ** | 1.81 | 2.47 | -0.66 | -2.44 | 0.02 | ** | 2.56 | 1.81 | 0.75 | 2.09 | 0.05 | ** |
| Volatility of monthly excess return | 1.78 | 2.58 | -0.80 | -2.44 | 0.02 | ** | 1.78 | 2.48 | -0.70 | -2.8 | 0.01 | *** | 2.52 | 1.78 | 0.74 | 2.56 | 0.02 | ** |
| Jensen alpha (Alpha1) | 0.39 | 0.27 | 0.11 | 1.81 | 0.07 | * | 0.39 | 0.24 | 0.15 | 1.99 | 0.05 | ** | 0.34 | 0.39 | -0.05 | -0.23 | 0.82 | |
| Alpha2 | 0.35 | 0.11 | 0.24 | 2.24 | 0.03 | ** | 0.35 | 0.07 | 0.28 | 2.52 | 0.01 | ** | 0.42 | 0.35 | 0.07 | 0.27 | 0.79 | |
| Beta | 0.67 | 0.71 | -0.04 | -0.31 | 0.76 | | 0.67 | 0.53 | 0.14 | 1.28 | 0.20 | | 0.90 | 0.67 | 0.22 | 0.97 | 0.34 | |
| Beta1 | 0.63 | 0.87 | -0.24 | -1.32 | 0.19 | | 0.63 | 0.72 | -0.08 | -0.58 | 0.56 | | 0.84 | 0.63 | 0.21 | 0.8 | 0.43 | |
| Beta2 | 0.06 | 0.21 | -0.15 | -0.73 | 0.47 | | 0.06 | 0.35 | -0.29 | -1.05 | 0.29 | | -0.24 | 0.06 | -0.30 | -0.98 | 0.33 | |
| Maximal monthly loss | -6.59 | -7.86 | 1.27 | 0.85 | 0.40 | | -6.59 | -6.59 | 0.00 | 0 | 1.00 | | -10.43 | -6.59 | -3.84 | -1.35 | 0.19 | |
| Maximal monthly excess loss | -6.08 | -7.72 | 0.99 | 1.39 | 0.17 | | -6.08 | -6.87 | 0.99 | 0.82 | 0.41 | | -9.27 | -6.08 | -3.19 | -1.28 | 0.21 | |
| Maximal drawdown | -7.90 | -11.00 | 3.13 | 1.46 | 0.15 | | -7.90 | -7.80 | -0.10 | -0.110 | 0.91 | | -11.90 | -7.90 | -4.00 | -1.210 | 0.24 | |
| Average drawdown | -2.40 | -3.30 | 0.87 | 1.66 | 0.10 | | -2.40 | -2.90 | 0.57 | 1.080 | 0.28 | | -5.20 | -2.40 | -2.80 | -1.450 | 0.16 | |
| proportion of recovering maximal loss | 0.95 | 0.98 | -0.03 | -0.90 | 0.37 | | 0.9462 | 0.7797 | 0.1666 | 2.81 | 0.01 | *** | 0.52 | 0.95 | -0.42 | -3.89 | 0.00 | *** |
| proportion of recovering maximal drawdown | 0.89 | 0.88 | 0.01 | 0.20 | 0.85 | | 0.8925 | 0.7966 | 0.0959 | 1.55 | 0.12 | | 0.48 | 0.89 | -0.41 | -3.72 | 0.00 | *** |
| proportion of recovering average drawdown | 1.00 | 1.00 | 0.00 | . | . | | 1 | 0.9831 | 0.0169 | 1 | 0.32 | | 0.96 | 1.00 | -0.04 | -1 | 0.33 | |
| Recovery rate | 0.87 | 0.84 | 0.03 | 1.21 | 0.23 | | 0.87 | 0.781 | 0.090 | 3.15 | 0.00 | *** | 0.86 | 0.87 | -0.01 | -0.260 | 0.80 | |
| Relative Recovery rate | 0.84 | 0.82 | 0.02 | 0.81 | 0.42 | | 0.84 | 0.748 | 0.096 | 3.14 | 0.00 | *** | 0.83 | 0.84 | -0.02 | -0.510 | 0.61 | |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

| Variables | Live funds of Group2 for nondirectional style | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | vs. Live funds of Group3 | | | | | | vs. Defunct funds of Group2 | | | | | |
| | Mean--Group2 | Mean--Group3 | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| Average monthly return | 0.97 | 0.81 | 0.16 | 1.79 | 0.08 | * | 1.04 | 0.97 | 0.07 | 0.39 | 0.70 | |
| Average monthly excess return | 0.14 | -0.02 | 0.16 | 1.97 | 0.05 | * | 0.29 | 0.14 | 0.15 | 0.82 | 0.41 | |
| Volatility of monthly return | 2.59 | 2.47 | 0.12 | 0.30 | 0.76 | | 2.71 | 2.59 | 0.12 | 0.23 | 0.82 | |
| Volatility of monthly excess return | 2.58 | 2.48 | 0.10 | 0.25 | 0.80 | | 2.83 | 2.58 | 0.26 | 0.56 | 0.58 | |
| Jensen alpha (Alpha1) | 0.27 | 0.24 | 0.04 | 0.42 | 0.68 | | 0.46 | 0.27 | 0.19 | 0.68 | 0.50 | |
| Alpha2 | 0.11 | 0.07 | 0.04 | 0.28 | 0.78 | | 0.32 | 0.11 | 0.22 | 0.54 | 0.59 | |
| Beta | 0.71 | 0.53 | 0.18 | 1.29 | 0.20 | | 0.56 | 0.71 | -0.15 | -0.58 | 0.57 | |
| Beta1 | 0.87 | 0.72 | 0.15 | 0.77 | 0.44 | | 0.84 | 0.87 | -0.03 | -0.05 | 0.96 | |
| Beta2 | 0.21 | 0.35 | -0.14 | -0.50 | 0.62 | | -0.03 | 0.21 | -0.23 | -0.33 | 0.75 | |
| Maximal monthly loss | -7.86 | -6.59 | -1.26 | -0.83 | 0.41 | | -9.23 | -7.86 | -1.38 | -0.70 | 0.49 | |
| Maximal monthly excess loss | -7.72 | -6.87 | -0.84 | -0.65 | 0.51 | | -9.48 | -7.72 | -1.77 | -1.03 | 0.31 | |
| Maximal drawdown | -11.00 | -7.80 | -3.30 | -1.54 | 0.13 | | -11.10 | -11.00 | -0.03 | -0.01 | 0.99 | |
| Average drawdown | -3.30 | -2.90 | -0.30 | -0.44 | 0.66 | | -4.80 | -3.30 | -1.50 | -1.70 | 0.09 | * |
| proportion of recovering maximal loss | 0.98 | 0.78 | 0.20 | 3.31 | 0.00 | *** | 0.52 | 0.98 | -0.46 | -5.04 | <.0001 | *** |
| proportion of recovering maximal drawdown | 0.88 | 0.80 | 0.08 | 1.11 | 0.27 | | 0.52 | 0.88 | -0.37 | -3.59 | 0.00 | *** |
| proportion of recovering average drawdown | 1.00 | 0.98 | 0.02 | 1.00 | 0.32 | | 0.88 | 1.00 | -0.12 | -2.10 | 0.04 | ** |
| Recovery rate | 0.84 | 0.78 | 0.06 | 1.71 | 0.09 | * | 0.78 | 0.84 | -0.06 | -1.28 | 0.21 | |
| Relative Recovery rate | 0.82 | 0.75 | 0.08 | 2.11 | 0.04 | ** | 0.76 | 0.82 | -0.06 | -1.34 | 0.19 | |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

| Variables | Live funds of Group3 for nondirectional style | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | vs. Defunct funds of Group2 | | | | | | vs. Defunct funds of Group3 | | | | | |
| | Defunct | Live | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| Average monthly return | 1.04 | 0.81 | 0.23 | 1.25 | 0.22 | | 0.45 | 0.81 | -0.36 | -3.70 | 0.00 | *** |
| Average monthly excess return | 0.29 | -0.02 | 0.32 | 1.76 | 0.09 | * | -0.43 | -0.02 | -0.41 | -4.34 | <.0001 | *** |
| Volatility of monthly return | 2.71 | 2.47 | 0.24 | 0.57 | 0.57 | | 3.79 | 2.47 | 1.32 | 3.68 | 0.00 | *** |
| Volatility of monthly excess return | 2.83 | 2.48 | 0.35 | 0.90 | 0.37 | | 3.67 | 2.48 | 1.19 | 3.48 | 0.00 | *** |
| Jensen alpha (Alpha1) | 0.46 | 0.24 | 0.22 | 0.79 | 0.43 | | -0.19 | 0.24 | -0.43 | -3.32 | 0.00 | *** |
| Alpha2 | 0.32 | 0.07 | 0.25 | 0.63 | 0.53 | | -0.30 | 0.07 | -0.37 | -1.99 | 0.05 | ** |
| Beta | 0.56 | 0.53 | 0.02 | 0.09 | 0.93 | | 0.63 | 0.53 | 0.09 | 0.65 | 0.51 | |
| Beta1 | 0.84 | 0.72 | 0.13 | 0.27 | 0.79 | | 0.73 | 0.72 | 0.01 | 0.07 | 0.94 | |
| Beta2 | -0.03 | 0.35 | -0.38 | -0.51 | 0.62 | | 0.58 | 0.35 | 0.23 | 0.43 | 0.67 | |
| Maximal monthly loss | -9.23 | -6.59 | -2.64 | -1.60 | 0.12 | | -10.18 | -6.59 | -3.59 | -3.45 | 0.00 | *** |
| Maximal monthly excess loss | -9.48 | -6.87 | -2.61 | -1.71 | 0.09 | * | -9.52 | -6.87 | -2.65 | -2.73 | 0.01 | *** |
| Maximal drawdown | -11.10 | -7.80 | -3.30 | -1.59 | 0.12 | | -13.30 | -7.80 | -5.50 | -4.33 | <.0001 | *** |
| Average drawdown | -4.80 | -2.90 | -1.80 | -2.15 | 0.03 | ** | -6.40 | -2.90 | -3.50 | -4.61 | <.0001 | *** |
| proportion of recovering maximal loss | 0.52 | 0.78 | -0.27 | -2.69 | 0.01 | *** | 0.38 | 0.78 | -0.40 | -5.56 | <.0001 | *** |
| proportion of recovering maximal drawdown | 0.52 | 0.80 | -0.28 | -2.91 | 0.00 | *** | 0.43 | 0.80 | -0.37 | -5.60 | <.0001 | *** |
| proportion of recovering average drawdown | 0.88 | 0.98 | -0.10 | -1.73 | 0.09 | * | 0.90 | 0.98 | -0.08 | -2.73 | 0.01 | *** |
| Recovery rate | 0.78 | 0.78 | 0.00 | 0.02 | 0.98 | | 0.60 | 0.78 | -0.18 | -5.56 | <.0001 | *** |
| Relative Recovery rate | 0.76 | 0.75 | 0.01 | 0.24 | 0.81 | | 0.56 | 0.75 | -0.19 | -5.33 | <.0001 | *** |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Table A2 Test of difference in the worse degree of performance between defunct funds and live funds over last M periods.
Panel A: Directional Type (funds are incepted before year 2000)
M=12 Month

| | | Difference in the worse degree of performance between defunct funds and live funds over last 12 months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Absolute performance (Absolute return) | | | | | | Relative performance (Excess return) | | | | | |
| Sample | Asset Group | Defunct | Live | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| ALL sample (Overlap) | Group1 | -1.11 | -0.17 | -0.94 | -3.82 | 0.00 | *** | -0.58 | -0.19 | -0.40 | -3.82 | 0.00 | *** |
| | Group2 | -1.17 | -0.29 | -0.88 | -3.56 | 0.00 | *** | -1.00 | -0.20 | -0.80 | -3.56 | 0.00 | *** |
| | Group3 | -0.93 | -0.30 | -0.63 | -5.32 | <.0001 | *** | -0.88 | -0.26 | -0.62 | -5.32 | <.0001 | *** |
| | All | -0.98 | -0.25 | -0.73 | -6.41 | <.0001 | *** | -0.91 | -0.22 | -0.69 | -6.41 | <.0001 | *** |
| ALL sample (No overlap) | Group1 | -1.60 | -0.24 | -1.35 | -3.97 | 0.00 | *** | -0.73 | -0.35 | -0.38 | -1.34 | 0.19 | |
| | Group2 | -1.89 | -0.47 | -1.42 | -3.43 | 0.00 | *** | -1.46 | -0.37 | -1.09 | -3.39 | 0.00 | *** |
| | Group3 | -1.50 | -0.54 | -0.96 | -4.66 | <.0001 | *** | -1.74 | -0.43 | -1.31 | -4.43 | <.0001 | *** |
| | All | -1.61 | -0.44 | -1.17 | -6.02 | <.0001 | *** | -1.72 | -0.38 | -1.35 | -5.12 | <.0001 | *** |

M=6 Month

| | | Difference in the worse degree of performance between defunct funds and live funds over last 6 months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Absolute performance (Absolute return) | | | | | | Relative performance (Excess return) | | | | | |
| Sample | Asset Group | Defunct | Live | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| ALL sample (Overlap) | Group1 | -1.22 | -0.23 | -0.98 | -2.32 | 0.02 | ** | -0.91 | -0.23 | -0.68 | -2.32 | 0.02 | ** |
| | Group2 | -1.55 | -0.40 | -1.15 | -3.20 | 0.00 | *** | -1.34 | -0.26 | -1.08 | -3.20 | 0.00 | *** |
| | Group3 | -1.50 | -0.40 | -1.10 | -4.91 | <.0001 | *** | -1.43 | -0.32 | -1.11 | -4.91 | <.0001 | *** |
| | All | -1.53 | -0.35 | -1.18 | -5.44 | <.0001 | *** | -1.44 | -0.27 | -1.17 | -5.44 | <.0001 | *** |
| ALL sample (No overlap) | Group1 | -1.41 | -0.28 | -1.13 | -2.31 | 0.03 | ** | -1.06 | -0.32 | -0.74 | -1.85 | 0.07 | * |
| | Group2 | -1.87 | -0.55 | -1.32 | -3.13 | 0.00 | *** | -1.59 | -0.36 | -1.24 | -3.35 | 0.00 | *** |
| | Group3 | -1.76 | -0.56 | -1.19 | -5.41 | <.0001 | *** | -1.97 | -0.44 | -1.53 | -4.53 | <.0001 | *** |
| | All | -1.75 | -0.47 | -1.28 | -6.27 | <.0001 | *** | -1.96 | -0.37 | -1.59 | -4.81 | <.0001 | *** |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Panel B: Non-directional Type (funds are incepted before year 2000)
M=12 Month

Difference in the worse degree of performance between defunct funds and live funds over last 12 months

| Sample | Asset Group | Absolute performance (Absolute return) | | | | | | Relative performance (Excess return) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Defunct | Live | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| ALL sample (Overlap) | Group1 | -0.84 | -0.16 | -0.682 | -3.43 | 0.0023 | *** | -0.47 | -0.14 | -0.33 | -1.72 | 0.0989 | * |
| | Group2 | -0.74 | -0.2 | -0.545 | -3.63 | 0.001 | *** | -0.67 | -0.12 | -0.56 | -3.59 | 0.0012 | *** |
| | Group3 | -0.67 | -0.24 | -0.437 | -4.1 | <.0001 | *** | -0.63 | -0.21 | -0.42 | -4.18 | <.0001 | *** |
| | All | -0.74 | -0.2 | -0.54 | -5.59 | <.0001 | *** | -0.65 | -0.17 | -0.49 | -5.5 | <.0001 | *** |
| ALL sample (No overlap) | Group1 | -1.10 | -0.28 | -0.813 | -2.86 | 0.0089 | *** | -0.54 | -0.26 | -0.28 | -1.03 | 0.3122 | |
| | Group2 | -1.13 | -0.53 | -0.598 | -2.29 | 0.0264 | ** | -0.94 | -0.22 | -0.72 | -3.35 | 0.0023 | *** |
| | Group3 | -1.12 | -0.46 | -0.667 | -3.13 | 0.0025 | *** | -1.05 | -0.35 | -0.70 | -4.02 | 0.0001 | *** |
| | All | -1.19 | -0.42 | -0.771 | -3.94 | 0.0001 | *** | -1.05 | -0.29 | -0.76 | -5.08 | <.0001 | *** |

M=6 Month

Difference in the worse degree of performance between defunct funds and live funds over last 6 months

| Sample | Asset Group | Absolute performance (Absolute return) | | | | | | Relative performance (Excess return) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Defunct | Live | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| ALL sample (Overlap) | Group1 | -1.382 | -0.193 | -1.189 | -2.80 | 0.0104 | ** | -0.959 | -0.17 | -0.79 | -2.09 | 0.0482 | ** |
| | Group2 | -0.92 | -0.224 | -0.697 | -2.61 | 0.014 | ** | -0.824 | -0.14 | -0.69 | -2.54 | 0.0169 | ** |
| | Group3 | -0.989 | -0.282 | -0.707 | -3.99 | 0.0001 | *** | -0.942 | -0.23 | -0.71 | -3.96 | 0.0002 | *** |
| | All | -1.113 | -0.239 | -0.875 | -5.39 | <.0001 | *** | -1.004 | -0.19 | -0.81 | -5.4 | <.0001 | *** |
| ALL sample (No overlap) | Group1 | -1.615 | -0.288 | -1.327 | -2.59 | 0.017 | ** | -1.07 | -0.22 | -0.85 | -1.91 | 0.0692 | * |
| | Group2 | -1.069 | -0.514 | -0.555 | -1.73 | 0.0865 | * | -0.94 | -0.21 | -0.73 | -2.38 | 0.024 | ** |
| | Group3 | -1.134 | -0.442 | -0.692 | -2.96 | 0.004 | *** | -1.18 | -0.30 | -0.88 | -4.05 | 0.0001 | *** |
| | All | -1.318 | -0.404 | -0.914 | -4.37 | <.0001 | *** | -1.23 | -0.26 | -0.97 | -5.30 | <.0001 | *** |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Panel C: Directional Type (funds are incepted after year 2000)

| | | Difference in the worse degree of performance between defunct funds and live funds over last M months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Absolute performance (Absolute return) | | | | | | Relative performance (Excess return) | | | | | |
| Sample | Asset Group | Defunct | Live | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| M=12 month Overlap | Group1 | -1.20 | -0.20 | -1.01 | -3.81 | 0.00 | *** | -0.57 | -0.16 | -0.41 | -3.81 | 0.00 | *** |
| | Group2 | -1.38 | -0.30 | -1.08 | -3.25 | 0.00 | *** | -1.08 | -0.16 | -0.93 | -3.25 | 0.00 | *** |
| | Group3 | -0.96 | -0.36 | -0.60 | -4.38 | <.0001 | *** | -0.88 | -0.27 | -0.61 | -4.38 | <.0001 | *** |
| | All | -1.00 | -0.29 | -0.71 | -5.52 | <.0001 | *** | -0.87 | -0.20 | -0.68 | -5.52 | <.0001 | *** |
| M=6 month Overlap | Group1 | -1.29 | -0.26 | -1.03 | -2.23 | 0.03 | ** | -0.91 | -0.20 | -0.71 | -2.23 | 0.03 | ** |
| | Group2 | -1.67 | -0.41 | -1.26 | -3.03 | 0.00 | *** | -1.33 | -0.20 | -1.13 | -3.03 | 0.00 | *** |
| | Group3 | -1.51 | -0.47 | -1.04 | -4.31 | <.0001 | *** | -1.40 | -0.33 | -1.08 | -4.31 | <.0001 | *** |
| | All | -1.50 | -0.39 | -1.11 | -4.84 | <.0001 | *** | -1.37 | -0.25 | -1.12 | -4.84 | <.0001 | *** |
| M=12 month No overlap | Group1 | -1.65 | -0.25 | -1.41 | -4.01 | 0.00 | *** | -0.72 | -0.28 | -0.43 | -1.49 | 0.14 | |
| | Group2 | -1.90 | -0.44 | -1.46 | -3.33 | 0.00 | *** | -1.47 | -0.24 | -1.23 | -3.36 | 0.00 | *** |
| | Group3 | -1.50 | -0.58 | -0.92 | -4.15 | <.0001 | *** | -1.57 | -0.38 | -1.20 | -4.00 | 0.00 | *** |
| | All | -1.57 | -0.45 | -1.12 | -5.49 | <.0001 | *** | -1.56 | -0.30 | -1.26 | -4.74 | <.0001 | *** |
| M=6 month No overlap | Group1 | -1.46 | -0.29 | -1.17 | -2.26 | 0.03 | ** | -1.03 | -0.26 | -0.77 | -1.78 | 0.08 | * |
| | Group2 | -1.94 | -0.53 | -1.41 | -3.00 | 0.00 | *** | -1.51 | -0.25 | -1.27 | -3.23 | 0.00 | *** |
| | Group3 | -1.70 | -0.60 | -1.10 | -4.67 | <.0001 | *** | -1.88 | -0.40 | -1.49 | -4.27 | <.0001 | *** |
| | All | -1.66 | -0.48 | -1.18 | -5.43 | <.0001 | *** | -1.83 | -0.30 | -1.52 | -4.54 | <.0001 | *** |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level

Panel D: Non-directional Type(funds are incepted after year 2000)

| | | Difference in the worse degree of performance between defunct funds and live funds over last M months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Absolute performance (Absolute return) | | | | | | Relative performance (Excess return) | | | | | |
| Sample | Asset Group | Defunct | Live | DIF | T value | P_value | | Defunct | Live | DIF | T value | P_value | |
| M=12 month Overlap | Group1 | -0.99 | -0.17 | -0.817 | -3.21 | 0.0048 | *** | -0.585 | -0.145 | -0.44 | -1.73 | 0.1003 | |
| | Group2 | -0.84 | -0.22 | -0.625 | -3.88 | 0.0006 | *** | -0.749 | -0.126 | -0.624 | -3.58 | 0.0015 | *** |
| | Group3 | -0.78 | -0.32 | -0.46 | -3.69 | 0.0004 | *** | -0.717 | -0.273 | -0.444 | -3.74 | 0.0004 | *** |
| | All | -0.83 | -0.24 | -0.598 | -5.48 | <.0001 | *** | -0.732 | -0.188 | -0.544 | -5.4 | <.0001 | *** |
| M=6 month Overlap | Group1 | -1.66 | -0.21 | -1.46 | -2.71 | 0.01 | ** | -1.14 | -0.17 | -0.97 | -1.99 | 0.06 | * |
| | Group2 | -1.11 | -0.26 | -0.85 | -2.93 | 0.01 | *** | -0.98 | -0.15 | -0.83 | -2.75 | 0.01 | ** |
| | Group3 | -1.03 | -0.38 | -0.65 | -3.34 | 0.00 | *** | -0.96 | -0.31 | -0.66 | -3.28 | 0.00 | *** |
| | All | -1.20 | -0.28 | -0.92 | -5.43 | <.0001 | *** | -1.07 | -0.22 | -0.85 | -5.43 | <.0001 | *** |
| M=12 month No overlap | Group1 | -1.22 | -0.28 | -0.94 | -2.72 | 0.01 | ** | -0.66 | -0.26 | -0.41 | -1.19 | 0.25 | |
| | Group2 | -1.18 | -0.53 | -0.65 | -2.45 | 0.02 | ** | -1.03 | -0.23 | -0.80 | -3.34 | 0.00 | *** |
| | Group3 | -1.19 | -0.52 | -0.67 | -2.93 | 0.00 | *** | -1.13 | -0.41 | -0.71 | -3.82 | 0.00 | *** |
| | All | -1.24 | -0.43 | -0.80 | -3.91 | 0.00 | *** | -1.12 | -0.31 | -0.81 | -5.00 | <.0001 | *** |
| M=6 month No overlap | Group1 | -1.86 | -0.29 | -1.58 | -2.55 | 0.02 | ** | -1.25 | -0.22 | -1.03 | -1.82 | 0.09 | * |
| | Group2 | -1.25 | -0.52 | -0.73 | -2.17 | 0.03 | ** | -1.11 | -0.22 | -0.90 | -2.65 | 0.01 | ** |
| | Group3 | -1.17 | -0.51 | -0.66 | -2.85 | 0.01 | *** | -1.15 | -0.38 | -0.78 | -3.29 | 0.00 | *** |
| | All | -1.37 | -0.42 | -0.95 | -4.64 | <.0001 | *** | -1.27 | -0.28 | -0.99 | -5.29 | <.0001 | *** |

Note: *** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level and * indicates statistical significance at the10% level