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Analysis of hedge fund performance

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Abstract

Using one of the largest hedge fund databases ever used (2796 individual funds including 801 dissolved), we investigate hedge funds performance using various asset pricing models, including an extension of Carhart's (1997) specification combined with the Fama and French (1998) and Agarwal and Naik (2002) models and a new factor that takes into account the fact that some hedge funds invest in emerging bond markets. This addition is particularly suitable for more than half of the hedge funds categories, and for all funds in general. The performance of hedge funds for several individual strategies and different subperiods, including the Asian Crisis period, indicates limited evidence of persistence in performance but not for extreme performers.

JEL classification: G2; G11; G15
Keywords: Hedge fund performance; Asset pricing models; Asian Crisis period

1. Introduction

With almost 6000 funds managing around $400 billion in capital, hedge funds justify an increased attention in financial press as well as in the academic world. These funds that have been existing for more than 50 years are not legally defined but share some common characteristics: they use a broad range of instruments like short selling, derivatives, leverage or arbitrage on different markets. Hedge funds require high minimum investments and their access is limited to individual investors or to institutions with large financial

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resources. Currently, about 90% of hedge fund managers are based in the US, 9% in Europe, and 1% in Asia and elsewhere. While the number of funds has more than doubled since the mid-1990s, around 80% of hedge funds are smaller than $100 million, and around 50% are smaller than $12 million. This reflects the high number of recent entries.

Scientific literature on performance-evaluation yields controversial results. This lack of consensus on the «right» model puts researchers in a quandary (Metrick, 1999). This paper investigates hedge funds performance levels and persistence using various asset-pricing models, including an extension of Carhart's (1997) model, combined with the models of Fama and French (1998) and Agarwal and Naik (2002) and with a factor, never previously used in this context, accounting for the fact that some hedge funds invest in emerging bond markets. This analysis is carried out for different subperiods including the Asian Crisis period and for several individual hedge funds strategies.

The rest of the paper is organized as follows. Section 2 reviews some of the major mutual and hedge funds performance studies with a focus on the evolution in the models used. Section 3 sets out the performance models we will use. Section 4 provides a thorough description of our database. Section 5 brings some insights on hedge fund performance. Section 6 reports the performance of hedge funds. Section 7 documents and explains the persistence in hedge fund returns. Section 8 concludes the paper.

2. Literature review

2.1. Performance studies

Despite the increasing interest that hedge funds have originated due to their recent development, few performance studies have been carried out on hedge funds comparing to other investment tools like mutual funds. This can partly be explained by their private characteristics and the difficulties encountered to have access to individual funds data. Therefore, it is interesting to succinctly consider the results obtained in the main performance studies of mutual funds before introducing results of studies on hedge funds.

In general, performance studies can mainly be classified in two categories, depending on whether they conclude or deny that mutual funds have significantly higher realized returns that those obtained by following passive strategies,[1] inducing that managers of mutual funds have access to sufficient information to recover their costs.

Among studies finding superior mutual funds performance, numerous papers investigate further its persistence. On the one hand, Hendricks et al. (1993), Goetzmann and Ibbotson (1994), Brown and Goetzmann (1995), and Wermers (1996) show persistence in mutual funds performance for a short period (1–3 years), and attribute it to *hot hands*[2] or to common investment strategies. It is worth noting that Carhart (1997) and Daniel et al.

[1] See a.o Lehmann and Modest (1987), Ippolito (1989), and Grinblatt and Titman (1989, 1992) for contenders of superior performance of hedge funds, and Jensen (1969), Malkiel (1995), Gruber (1996), and Carhart (1997) for studies reaching the opposite conclusion.

[2] This effect means that the securities held by funds that had better performance during one year realize superior returns than other funds the following year.

(1997) demonstrate that the momentum effect in the share's returns explain the *hot hands* effect detected by Hendricks et al. (1993). On the other hand, Ippolito (1989), Grinblatt and Titman (1989, 1992), Elton et al. (1993, 1996), Sirri and Tufano (1998), and Zheng (1999) report some predictability in the mutual funds returns over a longer period of time.

Considering the recent interest for this sector, studies on hedge funds persistence in performance are less frequent. Nevertheless, Agarwal and Naik (2000) sustain that persistence in hedge funds performance exists. This issue of persistence in performance is particularly important in the case of hedge funds because, as emphasized by Brown et al. (1999), Brown, Goetzmann, Hiraki, Otsuki and Shiraishi (2001), Brown, Goetzmann and Park (2001) and Liang (1999), hedge funds experience an attrition rate much higher than mutual funds. Brown et al. (1999) prove that offshore hedge funds display positive returns adjusted for risk but they attribute this performance to style effect and conclude that there is hardly any evidence of the existence of differential manager skills.

Ackermann et al. (1999) and Liang (1999) who compare the performance of hedge funds to mutual funds and several indices find that hedge funds constantly obtain better performance than mutual funds, although lower than the market indices considered. They also indicate that the returns in hedge funds are more volatile than both the returns of mutual funds and those of market indices. Ackermann and Ravenscraft (1998) emphasize that the stronger legal limitations for mutual funds than for hedge funds hinder their performance. According to Brown, Goetzmann, Hiraki, Otsuki and Shiraishi (2001) and Brown, Goetzmann and Park (2001), hedge funds showing good performance in the first part of the year reduce the volatility of their portfolio in the second half of the year.

Fung and Hsieh (1997) and Schneeweis and Spurgin (1997) prove that the insertion of hedge funds in a portfolio can significantly improve its risk-return profile, thanks to their weak correlation with other financial securities. This low correlation is also emphasized by Liang (1999) and Agarwal and Naik (2000). Amin and Kat (2001) find that stand-alone investment hedge funds do not offer a superior risk-return profile, but that a great majority of funds classified as inefficient on a stand-alone basis are able to produce an efficient payoff profile when mixed with the S&P500. They obtain the best results when 10–20% of the portfolio value is invested in hedge funds. Taking all these results into account, hedge funds seem a good investment tool.

2.2. Evolution in performance measurement

In the 1980s, performance measures based on the CAPM, like Jensen's alpha (1968) and their extensions were commonly used in performance evaluation. The recent interest in multi-factor models primarily comes from the literature on the cross-sectional variations in stock return. Several studies[3] report that the cross-section of average returns on US common stocks shows little relation to the betas of the Sharpe (1964)–Lintner (1965) CAPM or the Breeden (1979) ICAPM. Instead, these authors identify other factors like the size of the company (Banz, 1981), leverage (Bhetari, 1988), earnings/price (Basu, 1983), book-to-market (Rosenberg et al., 1985; Fama and French, 1992), dividend yield (Litzenberger and Ramaswamy, 1979, 1982), and, more recently, the momentum effect

[3] See e.g Reinganum (1981), Breeden et al. (1989), Fama and French (1996), and Chan et al. (1996).

(Jegadeesh and Titman, 1993; Carhart, 1995) that have reliable power to explain the cross-section of average returns.

Subsequent multi-factor models include the eight-factor model developed by Grinblatt and Titman (1994), the asset class factor model from Sharpe (1992), the three-factor model from Fama and French (1993), the four-factor model from Carhart (1997), and the international model of Fama and French (1998).[4]

However, recent studies have cast doubt on the usefulness of these new models. Kothari and Warner (2001) show that the Fama and French (1993) three-factor model provides better results than the classical CAPM, but document that it detects significant abnormal results (including timing) when none really exists. In addition, Carhart (1997) develops his own four-factor model that proves to be superior to the classical CAPM, the Grinblatt and Titman (1989) eight-factor model, and the Fama and French (1993) three-factor model.

In hedge funds literature, different models have also been used in performance evaluation. In an early study, Fung and Hsieh (1997) extend Sharpe's (1992) asset class factor model and find five dominant investment styles in hedge funds. Schneeweis and Spurgin (1998) also use style analysis based on a multi-factor approach. Brown et al. (1999) and Ackermann et al. (1999) use a single-factor model and focus only on total risk. Agarwal and Naik (2000) use regression-based (parametric) and contingency-table-based (nonparametric) methods. Their parametric method regresses alphas (or appraisal ratios) on their lags. For the nonparametric method, they construct a contingency table of winners and losers depending on the alpha. Liang (1999) uses the extension of Fung and Hsieh (1997) model, regressions based on fund characteristics, and classical measure like the Sharpe ratio. Agarwal and Naik (2002) propose a general asset class factor model comprising of excess returns on passive option-based strategies and on buy-and-hold strategies to benchmark the performance of hedge funds. Agarwal (2001) uses a model consisting of trading strategy factors and location factors to explain the variation in hedge funds returns over time.

These results suggest that it is necessary to realize performance studies based on multi-factor models, rather than simply use the CAPM, but there exists no unanimously accepted model. Therefore, it is preferable to use several specifications in order to compare the results obtained.

3. Performance measurement models

For comparison purposes, our study of hedge funds performance starts with the CAPM. The basic multi-factor specifications are the Fama and French (1993) three-factor model and its international version of 1998 (Fama and French, 1998) and the Carhart (1997) model because they are not dominated by any other model in the mutual funds performance literature.[5] Finally, we construct a multi-factor model that extends the Carhart

[4] See Allen and Soucik (2000) for a description of the major models used in mutual funds performance studies.

[5] Following Bams and Otten (2002) we do not consider the Sharpe's (1992) asset class factor model which is an asset allocation model and not an asset evaluation model.

(1997) model by combining it with factors proposed in Fama and French (1998) model and Agarwal and Naik (2000) and by adding an additional factor.

3.1. The capital asset pricing model

The first performance model we use is a single index model based on the classical CAPM developed by Sharpe (1964) and Lintner (1965). Its equation to estimate is the following:

$$R_{Pt} - R_{Ft} = \alpha_P + \beta_P(R_{Mt} - R_{Ft}) + \varepsilon_{Pt} \qquad t = 1, 2, \ldots, T \tag{1}$$

where R_{Pt} = return of fund P in month t; R_{Ft} = risk-free return on month t; R_{Mt} = return of the market portfolio on month t; ε_{Pt} = error term; α_P and β_P are the intercept and the slope of the regression, respectively.

The intercept of this equation, α_p, commonly called Jensen's alpha (1968), is usually interpreted as a measure of out- or under-performance relative to the market proxy used.

3.2. The three-factor model of Fama and French (1993) and its international version of Fama and French (1998)

The Fama and French (1993) three-factor model is estimated from an expected form of the CAPM regression. It takes the size and the book-to-market ratio of the firms into account. It is estimated from the following extension of the CAPM regression:

$$R_{Pt} - R_{Ft} = \alpha_P + \beta_{P1}(R_{Mt} - R_{Ft}) + \beta_{P2}\mathrm{SMB}_t + \beta_{P3}\mathrm{HML}_t + \varepsilon_{Pt} \qquad t = 1, 2, \ldots, T$$

where SMB_t = the factor-mimicking portfolio for size ('small minus big') and HML_t = the factor-mimicking portfolio for book-to-market equity ('high minus low').[6] These factors aim at isolating the firm-specific components of returns.

In the international version of the model, Fama and French (1998) consider 12 major EAFE (Europe, Australia, and Far East) countries and several emerging markets and propose an international factor mimicking for book-to-market equity (HML). The formula is the following:

$$R_{Pt} - R_{Ft} = \alpha_P + \beta_{P1}(R_{Mt} - R_{Ft}) + \beta_{P2}\mathrm{IHML}_t + \varepsilon_{Pt} \qquad t = 1, 2, \ldots, T \tag{2}$$

where IHML_t = an international version of HML_t.

According to Fama and French (1998), the international CAPM cannot explain the value premium in international returns, but a one-state-variable international ICAPM that explains returns with the global market return and a risk factor for relative distress captures the value premium in country and global returns.

[6] See Fama and French (1993) for a precise description of the construction of SMB_t and HML_t.

3.3. The four-factor model of Carhart (1997)

Carhart's (1997) four-factor model is an extension of the Fama and French (1993) factor model. It takes into account not only the size and book-to-market ratio, but also an additional factor for the momentum effect. Grinblatt et al. (1995) define this effect as buying stocks that were past winners and selling past losers. This model is estimated with the following regression:

$$R_{Pt} - R_{Ft} = \alpha_P + \beta_{P1}(R_{Mt} - R_{Ft}) + \beta_{P2}\mathrm{SMB}_t + \beta_{P3}\mathrm{HML}_t + \beta_{P4}\mathrm{PR1YR}_t + \varepsilon_{Pt}$$
$$t = 1, 2, \ldots, T \tag{3}$$

where $\mathrm{PR1YR}_t$ = the factor-mimicking portfolio for the momentum effect[7]

As stressed by Daniel et al. (1997), this model assumes that, in the absence of stock selection or timing abilities, the coefficients of four zero-investment factor-mimicking portfolios are appropriate measures of multidimensional systematic risk. It identifies a matching passive portfolio return for each fund return.

3.4. An extended multi-factor model

In order to take into account the different characteristics of the hedge fund industry, we implement a combination and an extension of Carhart's (1997) four-factor model, the international model of Fama and French (1998), and the model used by Agarwal and Naik (2002) and Agarwal (2001).

This model contains the zero-investment strategies representing Fama and French's (1993) size and value, Fama and French (1998) international value and Carhart's (1997) momentum factor, a default factor (Lehman BAA Corporate Bond Index) as introduced by Agarwal and Naik (2002), a factor for non-US equities investing funds (MSCI World excluding US), three factors to take into account the fact that hedge funds invest in US and foreign bond indices (Lehman US Aggregate Bond Index, Salomon World Government Bond Index, and JP Morgan Emerging Market Bond Index), and, finally, a commodity factor (Golman Sachs Commodity Index). Beyond the combination of existing models, the originality of this model is to feature a factor that takes into account the fact that hedge funds may invest in bonds on emerging markets.

In order account for the fact that hedge funds invest in a wide range of equities including small and large companies, the market proxy used is the Russel 3000 that represents over 95% of investable US equity market.

Note that Agarwal and Naik (2002) and Agarwal (2001) take several additional factors such as the MSCI Emerging Markets, the Salomon Brothers Government and Corporate Bond Index, and the Lehman High Yield Bond Index. Their high colinearity with other factors led us not to test these indices further.

Following Agarwal (2001), we choose the Goldman Sachs Commodity Index instead of a Gold Index used by Fung and Hsieh (1997) as the former indicates better exposure of

[7] For a description of the construction of PR1YR see Carhart (1997).

hedge funds in commodities especially considering the fact that hedge funds may not be investing solely in gold among commodities. Its components are weighted according to their impact on production in the world economy.

$$\begin{aligned} R_{Pt} - R_{Ft} = {} & \alpha_P + \beta_{P1}(R_{Mt} - R_{Ft}) + \beta_{P2}\mathrm{SMB}_t + \beta_{P3}\mathrm{HML}_t + \beta_{P4}\mathrm{IHML}_t \\ & + \beta_{P4}\mathrm{PR1YR}_t + \beta_{P5}(\mathrm{MSWXUS}_t - R_{Ft}) + \beta_{P7}(\mathrm{LAUSBI}_t - R_{Ft}) \\ & + \beta_{P8}(\mathrm{SWGBI}_t - R_{Ft}) + \beta_{P9}(\mathrm{JPMEMBI}_t - R_{Ft}) \\ & + \beta_{P10}(\mathrm{LEHBAA}_t - R_{Ft}) + \beta_{P11}(\mathrm{GSCI}_t - R_{Ft}) + \varepsilon_{Pt} \end{aligned} \quad (4)$$

where R_{Mt} = return on the Russel 3000 index; MSWXUS_t = return of the MSCI World Index excluding US; LAUSBI_t = return on the Lehman Aggregate US Bond Index; SWGBI_t = return on the Salomon World Government Bond Index; $\mathrm{JPMEMBI}_t$ = return of the JP Morgan Emerging Market Bond Index; LEHBAA_t = return of the Lehman BAA Corporate Bond Index; GSCI_t = return of the Goldman Sachs Commodity Index.

4. Data

4.1. Data providers

First, it is important to stress all information on hedge funds is available exclusively on a voluntary basis, for 'allowed' persons depending on the country in which the fund wants to find investors. Fortunately, many hedge funds release monthly information to inform existing investors or to attract new ones. Some data collectors make them, in turn, available to the qualifying public. As stressed by Amin and Kat (2001), there are three main hedge fund database providers in the world. These are 'Managed Account Reports' (MAR, 1500 funds), 'Hedge Fund Research' (HFR, 1400 funds), and 'TASS Management' (TASS, 2200 funds). These databases are the most used in academic and commercial hedge fund studies. The MAR database is used, among others, by Fung and Hsieh (1997), Schneeweis and Spurgin (1998), and Amin and Kat (2001). HFR is used by Schneeweis and Spurgin (1997), Liang (1999), Agarwal and Naik (2000, 2002), and Agarwal (2001). The TASS database is used in Fung and Hsieh (2000, 2001), Brown, Goetzmann, Hiraki, Otsuki and Shiraishi (2001) and Brown, Goetzmann and Park (2001). The three databases have never been used together in a study, but Ackermann et al. (1999) and Ackermann and Ravenscraft (1998) used a combination of HFR and MAR. Liang (2000) uses a combination of TASS and HFR.

Data vendors do not only collect performance data. For a majority of funds, they record other useful information such as company name, start and ending date, strategy followed, assets under management, management and incentive fees, managers name, etc. There is no consensus on the definition of the strategy followed but there are similarities. MAR defines nine strategies along with 15 sub-strategies. HFR defines 16 investment strategies in two categories, 12 non-directional and 4 directional strategies, plus the Funds of Funds and the Sector categories. Finally, TASS defines 15 strategies.

4.2. Hedge funds

We use hedge fund data from HFR and MAR, similarly to Ackermann et al. (1999), whose database ranges from 1988 to 1995. Both databases give monthly net-of-fee individual returns and other information on individual funds and group them in indices. The HFR database provides 198 monthly returns on 1811 individual hedge funds plus 48 HFR indices (16 investment styles with three indices for each investment style: onshore, offshore, and a combined index), and the MAR database gives 2354 individual hedge funds plus 23 indices between January 1984 and June 2000. Then, in each database, we remove funds that appear twice[8] and funds with quarterly returns. This leaves us with 1639 individual hedge funds in the HFR database and 2014 hedge funds in the MAR database. For the 857 funds present in both databases, we use the database presenting more observations.

This leaves a total of 2796 individual hedge funds. This is one of the greatest database ever used in hedge funds performance studies. These funds include 1995 (71%) survived funds and 801 (29%) dissolved funds.

4.3. Risk-free return and market performance

As underlined by Agarwal (2001), a fundamental challenge in a risk-adjusted analysis of hedge funds is the identification of a meaningful benchmark. Fung and Hsieh (1997), Schneeweis and Spurgin (1998), and Liang (1999) use style analysis based multi-factor approach, while Brown et al. (1999) address this issue by employing a Generalized Stylistic Classification (GSC) algorithm and grouping the managers on the basis of their realized returns.

We have to choose a market performance index. The alternative is the value-weighted portfolio of all NYSE, Amex and Nasdaq stocks usually used in mutual funds performance studies (see, for example, Fama and French, 1993, 1996, 2000; Carhart, 1997), or the Russel 3000 used in Agarwal and Naik (2002) and Agarwal (2001). The comparison of descriptive statistics of the two proxies suggests that both market proxies are very similar.[9] The results of the study should not be influenced by the market proxy chosen.

We take the value-weighted portfolio of all NYSE, Amex and Nasdaq stocks market proxy, and the 1-month T-bill from Ibbotson Associates as the risk-free rate.

4.4. Biases in hedge funds data

Survivorship bias is an important issue in mutual funds performance studies (see Carhart et al., 2000). In response to this concern, data vendors do backfill fund's

[8] This happened in three cases: when the same fund (same name, company, and returns) appeared twice in the database; when the same fund (same name, and returns) appeared twice in the database with two different company names; and when the same fund (same company, and returns) appeared twice in the database with two different fund names.

[9] The comparison is available upon request.

performance history when a new fund is added to the database. This allows them to provide data that go back before the starting date of the database itself (usually 1993).

These providers do not eliminate defunct funds and should normally not suffer from survivorship bias for the years after the start of the databases. However, as pointed out in several other studies (see Brown, Goetzmann, Hiraki, Otsuki and Shiraishi, 2001; and Brown, Goetzmann and Park, 2001), survivorship bias is very likely to be present and not negligible, although hardly measurable, for the period before 1994. This bias may severely hinder statistical inference (Hendricks et al., 1993; Carhart et al., 2000).

Moreover, according to Ackermann et al. (1999) and to Fung and Hsieh (2000), two upward biases exist in the specific case of hedge funds because, since they are not allowed to advertise, they consider inclusion in a database primarily as a marketing tool. The first one is called the *self-selection bias* is present because funds that realize good performance have less incentive to report their performance to data providers in order to attract new investors, because they might be considered by the SEC as making illegal advertising. The second bias called *instant history bias* or *backfilled bias* (Fung and Hsieh, 2000) occurs because a fund's performance history is backfilled after inclusion. This may cause an upward bias because funds with a poor track record are less likely to apply for inclusion than funds with good performance history. Nevertheless, to avoid polemics, we take all funds (both living and dissolved) into account.

5. Data analysis

We will first discuss evidence of biases before and after 1994 in our database, as evidence of a serious difference in these two subperiods would cast doubt on the reliability of the global analysis for the 1984–2000 period.

5.1. Survivorship bias

Survivorship bias has received considerable attention in the academic literature. Two definitions of this bias are commonly used in studies: the performance difference between surviving funds and dissolved funds (e.g. Ackermann et al., 1999), and the performance difference between living funds and all funds (e.g. Liang, 2000). We report the bias using both definitions for the whole period and for two subperiods 1984–1993 and 1994–2000.

In Panel A of Table 1, we report a monthly survivorship bias of 0.36% (or 4.45% per annum) for the whole period using the first formula and in Panel B a bias of 0.07% per month (0.9% per annum) using the second formula. A look at subperiod biases indicates that survivorship bias is much higher after 1994.

The particularly low estimate for the bias in the 1984–1993 period is due to the extremely low attrition rate of hedge funds in the database. As our sample does not report data on dissolved funds prior to 1994 for MAR and prior to 1993 for HFR, one is automatically left with funds that survived this period and thus survivorship is indeed qualitatively maximal. This indicates the lack of reliability of the database for this period.

Table 1
Survivorship bias in hedge funds

Year	All funds			Surviving funds			Dissolved funds		
	Return	St. Dev.	Obs.	Return	Std. Dev.	Obs.	Return	Std. Dev.	Obs.
1984	1.08	3.26	348	0.97	1.57	248	1.36	7.60	76
1985	2.55	1.44	501	2.83	1.61	356	1.87	1.34	121
1986	1.80	1.58	716	1.99	1.55	497	1.58	2.33	195
1987	1.50	4.16	1069	1.40	4.26	782	1.64	5.39	263
1988	1.72	1.54	1376	1.83	1.73	1020	1.44	1.03	332
1989	1.52	0.79	1931	1.65	0.87	1444	1.13	0.76	463
1990	0.74	1.16	2792	0.77	1.22	2063	0.61	1.32	705
1991	2.08	1.67	3880	2.07	1.96	2826	2.12	1.40	1030
1992	1.23	0.61	5280	1.24	0.74	3860	1.20	0.64	1396
1993	1.95	0.47	7245	1.91	0.48	5140	2.07	0.66	2081
1994	0.16	0.69	9856	0.16	0.79	6931	0.15	0.73	2901
1995	1.62	0.86	13 528	1.68	1.14	9298	1.48	0.58	4206
1996	1.69	0.75	17 654	1.66	0.77	11 942	1.75	0.97	5688
1997	1.51	0.81	22 454	1.60	0.75	15 122	1.35	1.30	7308
1998	0.46	10.08	25 735	0.78	11.94	18 440	−0.36	3.72	7271
1999	2.46	2.12	25 826	2.58	2.09	21 712	1.79	2.92	4090
2000	1.15	2.23	12 421	1.22	2.23	11 880	−1.00	3.30	529
Mean 1984–1993	1.62			1.67			1.50		
Mean 1994–2000	1.29			1.38			0.74		
Mean 1984–2000	1.48			1.55			1.19		

Panel A: Living funds − Dead funds			*Panel B*: Living funds − All funds		
Bias 1984–1993	0.16	per month	Bias 1984–1993	0.05	per month
	1.96	per year		0.60	per year
Bias 1994–2000	0.65	per month	Bias 1994–2000	0.09	per month
	7.79	per year		1.22	per year
Bias 1984–2000	0.36	per month	Bias 1984–2000	0.07	per month
	4.45	per year		0.89	per year

This table reports the survivorship bias of calculated from our database. Our combined HFR/TASS database contains 2796 hedge funds, including 1995 survived funds and 801 dissolved funds as of June 2000. In Panel A, survivorship bias is calculated as the performance difference between surviving funds and dissolved funds. In Panel B, survivorship bias is calculated as the performance difference between surviving funds and all funds. All returns are net of fees and on a monthly basis. Numbers in the table are monthly percentages.

Ackermann et al. (1999) use the same combination of databases as we do and the first definition of survivorship bias. Their value (0.16% per year) is lower than the value we obtain for the whole period and for the second subperiod (respectively 0.9% and 4.45% per year) and closer to the one we obtain for the first subperiod (0.6% per year). This difference can mostly be explained by the different time period analyzed. Ackermann et al. (1999) study the 1988–1995 period, i.e. the greatest part of their time window does not encompass funds that disappeared during the period. The issue of their suspiciously low survivorship bias has been extensively discussed by Fung and Hsieh (2000) and Liang (2000).

The value reported using the second definition for period 1994–2000 (1.2%) is very close to the percentage of 1.5% from Fung and Hsieh (2000). It is however

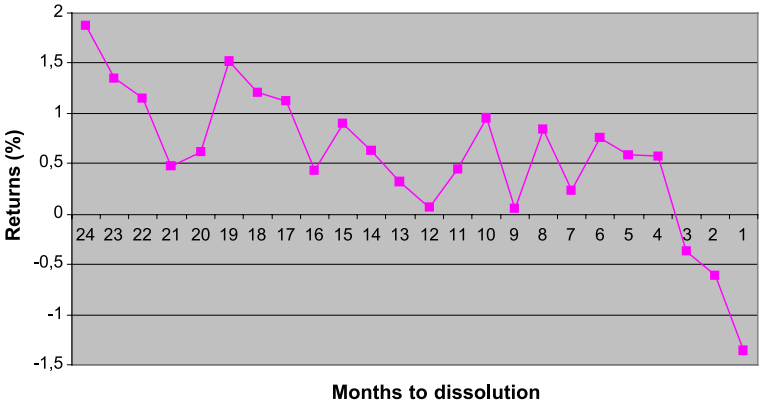

Fig. 1. Monthly returns for dead funds towards the dissolution date. Monthly returns are computed on the MAR/HFR database over the 24-month period before their exit dates. Data are obtained on 801 individual hedge funds between January 1984 and June 2000.

lower than the 0.30% monthly bias found by Fung and Hsieh (2000), the 3% bias found by Liang (2001), and the industry consensus bias of 3% stressed by Amin and Kat (2001).[10]

Liang (2000) compares the survivorship bias in HFR and TASS database and finds significant differences between them. He finds out that they are mostly nonoverlapping, but the TASS database is probably more complete as it covers a larger number of dissolved funds. Our relatively low survivorship is in line with Liang's (2000) claim that the HFR and MAR databases, taken together, do not fully resolve the survivorship issue, even though our sample covers a larger time period.

These biases suggest that poor performance could be the main reason for disappearance. Fig. 1 plots returns of the dissolved funds in our database over the 24-month period before their exit dates. It shows a declining return pattern towards the date of exit, indicating inferior performance: it corresponds to a decrease of the mean return of almost 3.5% in 2 years.

5.2. Instant return history bias

When new funds are added into a database, historical returns are backfilled. This corresponds to a demand by fund managers who market themselves if they have good track records, i.e. after compiling good performance. Fung and Hsieh (2000) estimate this bias using a 12-month incubation period. They find a 1.4% per year difference in returns for the 1994–1998 period.

Following Park (1995), Brown et al. (1999), and Fung and Hsieh (2000), we estimate this bias for our hedge fund database in two steps. On the one hand, we estimate the

[10] We find this consensus value quite high when compared to the 0.8–1.5 bias reported by Malkiel (1995) and Brown and Goetzmann (1995) for US mutual funds.

average monthly return using the portfolio that invests in all funds from our database each month (we called this portfolio the observable one). On the other, we estimate the average monthly return from investing in all these funds after deleting the first 12, 24, 36, and 60 months of returns (we called this portfolio the adjusted observable one). The bias is estimated for the whole period and splitting the time period in two in order to compare our results with those obtained by Fung and Hsieh (2000). Results are reported in Table 2.

For the 1/1984–6/2000 period, the observable monthly return averaged 1.49%, while the adjusted observable one was 1.42% (when deleting the 12 first months), 1.26% (24 months), 1.20% (36 months), and 1.15% (36 months). This gives an estimate of approximately 0.9% per year, lower than the 1.4% found by Fung and Hsieh (2000) for the instant history bias. For the 1/1994–6/2000 period, the bias of 1.2% per year is closer to the one of Fung and Hsieh (2000). The remaining difference can be explained by the difference in time period covered and in the database used. Interestingly, our results indicates that the longer the estimation period, the bigger the bias.

Contrarily to the results reported for the survivorship bias, Table 2 yields a consistently greater estimate of the instant history bias for the pre-1994 than the post-1994 period when 24 months or more are deleted.

Based on these pieces of evidence regarding the presence of biases, the rest of this paper will focus on performance level and persistence for the 1994–2000 subperiod, and only consider the 1984–1993 subperiod in isolation in order to compare the consistency of the results obtained and relate them to the presence of the biases of the database. Results for the whole 1984–2000 period are not reported because we may not soundly claim that the pre- and post-1994 time windows exhibit the same biases with the same severity.

Table 2
Estimation of instant return history bias

	1/1984–6/2000			1/1984–12/1993			1/1994–6/2000		
	Mean annual return	Difference	Average no. of funds per month	Mean annual return	Difference	Average no. of funds per month	Mean annual return	Difference	Average no. of funds per month
All	1.49%		768	1.62%		207	1.29%		1631
Without 12M	1.42%	0.08%	644	1.58%	0.04%	147	1.19%	0.10%	1308
Without 24M	1.26%	0.23%	527	1.35%	0.28%	103	1.16%	0.13%	1017
Without 36M	1.20%	0.29%	425	1.27%	0.35%	71	1.13%	0.16%	773
Without 60M	1.15%	0.35%	269	1.21%	0.41%	32	1.10%	0.19%	426

This table reports the instant history bias calculated from our database. Our combined database contains 2796 hedge funds, including 1995 survived funds and 801 dissolved funds as of June 2000. Instant history bias is calculated as the performance difference between the average monthly return using the portfolio which invests in all funds each month (the observable portfolio) and the average monthly return from investing in these funds after deleting the first 12, 24, 36, and 60 months of returns (the adjusted observable portfolio). All returns are net of fees and on a monthly basis. Numbers in the table are monthly percentages.

5.3. Basic performance

Before going into the heart of our work, Panel A of Table 3 contains descriptive statistics of the funds in our database, including living and dead funds. Given that MAR and HFR classify differently the individual hedge funds, we combine the data for strategies that exist across both databases (sometimes under different names) and we add the strategies or sub-strategies present in only one database.[11] We contrast hedge funds data against the descriptive statistics of the market proxy, the MSCI World excluding US, Fama and French's (1993) SML and HML, Fama and French's (1998) International IHML, Carhart's (1997) Momentum factor, Lehman US Aggregate Bond Index, Salomon World Government Bond Index, JP Morgan Emerging Market Bond Index, Lehman BAA Corporate Bond Index (default spread), and Goldman Sachs Commodity Index. These statistics are reported in Panel B of Table 3.

Panel A shows that the highest mean return was achieved by the US Opportunistics Small Caps (2.58%) followed by the US Opportunistics Growth (2.15%) and by the Sector (1.91%). Strategies that offer the lowest mean return are Foreign Exchange (0.64%), Short Sellers (0.71%) and Funds of Funds (0.78%), whereas the mean return of the whole database is 1.29%. The results are similar for mean excess returns.

When standard deviation is taken into account through the Sharpe measure (the ratio of excess return and standard deviation), results are somewhat different. Funds offering the best trade-off between risk and return are the US Opportunistics Small Caps (0.3814), followed by the Market Neutral Convertible Arbitrage (0.3633) and the Market Neutral Relative Value Arbitrage (0.2766). The worst Sharpe ratio is obtained by the Short Sellers (0.0465), which are also in the worst performing funds when risk is not taken into account.

A look at the *t*-stats indicates that mean returns are significantly different from 0 at the 5% significance level for all funds but the Short Sellers and that the mean excess returns are significantly different from 0 at the 1% level in a majority of cases.

Panel B of Table 3 shows that the mean excess return of the Market Proxy is 1.26% per month (about 16% per year) and statistically different from zero. This large value indicates that the period under study is unambiguously bullish. The mean excess premium of the MSCI World excluding US is an insignificant 0.43% per month. The average SMB and HML returns are insignificant, unlike the results obtained by Fama and French (1993) and Carhart (1997).[12] The International HML and the Momentum factor give more interesting values. They respectively produced an average premium of 0.28% and 1.15% per month, the latter being economically as well as statistically significant. The highest mean return was obtained by the Market Proxy for equity, and by the JP Morgan Emerging Market Bond Index for the bond. The Sharpe ratios bring the same results, with the only difference that the Lehman BAA Corporate (0.0842) has a Sharpe ratio very close to the one obtained by the JP Morgan Emerging Market Bond Index (0.1).

[11] The description of these strategies is available upon request.

[12] The differences in SMB and HML can be explained by the different periods covered by our studies. Their high variance suggests a very unstable behavior.

Table 3
Descriptive statistics of hedge funds strategies and passive investment strategies

Panel A: Hedge funds strategies

Hedge fund strategy	No. of funds	Sub-strategy	Living funds	Dead funds	Mean return	t(mean) = 0	Std. Dev.	Median	Min	Max	Mean excess return	t(mean excess) = 0	Sharpe ratio
Event Driven	108	100%	56	52	1.25	3.49	5.06	0.94	− 8.62	6.71	0.85	2.36	0.1680
Distressed Securities	49	45.4%	25	24	0.98	3.34	4.12	0.86	− 9.75	6.37	0.57	1.96	0.1395
Risk Arbitrage	50	46.3%	27	23	1.49	3.76	5.59	1.02	− 7.97	10.47	1.05	2.65	0.1884
No Sub-strategy	9	8.3%	4	5	1.08	5.53	2.76	1.32	− 8.79	6.47	0.68	3.47	0.2466
Global	349	100%	184	165	1.02	2.20	6.50	0.86	− 17.46	10.94	0.61	1.32	0.0941
International	62	17.8%	27	35	1.02	2.26	6.35	0.88	− 12.66	9.83	0.62	1.37	0.0972
Emerging	203	58.2%	123	80	0.94	1.98	6.69	0.75	− 20.01	11.56	0.54	1.13	0.0806
Regional Established	84	24.1%	34	50	1.36	4.20	4.56	1.12	− 8.97	9.54	0.96	2.96	0.2100
Global Macro	319		259	60	1.68	4.11	5.75	1.36	− 6.27	9.93	1.27	3.12	0.2216
Market Neutral	711	100%	522	189	1.06	3.78	3.95	0.92	− 3.36	5.29	0.66	2.34	0.1666
Long/Short	150	21.1%	83	67	1.31	4.20	4.41	0.98	− 1.70	6.54	0.91	2.91	0.2065
Convertible Arbitrage	44	6.2%	38	6	0.89	9.40	1.33	0.84	− 1.79	2.31	0.48	5.11	0.3633
Fixed Income	61	8.6%	50	11	0.79	2.50	4.43	0.65	− 5.62	7.99	0.38	1.22	0.0864
Stock Arbitrage	392	55.1%	309	83	1.08	3.98	3.81	0.97	− 4.59	6.10	0.67	2.49	0.1770
Mortgage-Backed Securities	56	7.9%	42	14	0.84	3.78	3.11	0.75	− 4.31	3.09	0.43	1.96	0.1389
Relative Value Arbitrage	8	1.1%	0	8	1.20	5.94	2.84	1.24	− 5.82	6.62	0.79	3.89	0.2766
Short Sellers	24		9	15	0.71	1.52	6.57	0.81	− 10.40	10.96	0.31	0.65	0.0465
US Opportunistics	212	100%	139	73	1.87	4.29	6.14	1.60	− 11.75	13.71	1.47	3.36	0.2390
Growth	88	41.5%	67	21	2.15	4.49	6.75	1.85	− 12.41	17.52	1.75	3.65	0.2592
Value	110	51.9%	61	49	1.61	4.21	5.38	1.27	− 11.74	10.20	1.20	3.15	0.2237
Small Caps	14	6.6%	11	3	2.58	6.36	5.71	2.41	− 7.92	17.53	2.18	5.37	0.3814
Long only Leveraged	27		16	11	1.73	3.31	7.33	1.24	− 14.47	15.64	1.32	2.54	0.1804
Market Timing	49		40	9	1.10	3.29	4.69	0.77	− 2.47	10.38	0.69	2.08	0.1476
Equity non-Hedge	120		86	34	1.68	3.53	6.70	1.41	− 14.535	11.2	1.28	2.68	0.1907
Foreign Exchange	9		9	0	0.64	9.29	0.97	0.61	− 5.46	3.05	0.23	3.42	0.2428

Sector	186	132	54	1.91	4.34	6.20	1.47	− 12.54	12.32	1.51	3.42	0.2430
Funds of Funds	347	229	118	0.78	3.55	3.09	0.80	− 8.70	6.83	0.38	1.71	0.1216
Non Classified	335	314	21	1.42	3.75	5.33	1.04	− 2.91	6.71	1.02	2.69	0.1910
All funds	2796	1995	801	1.29	3.27	5.56	1.01	− 7.88	7.87	0.89	2.25	0.1596‘

Panel B: Passive strategies

Passive strategy index	Mean Return	*t*(mean) = 0	Std. Dev.	Median	Min	Max	Mean excess return	*t*(excess mean) = 0	Sharpe ratio
Equity									
Market Proxy	1.64	5.75	4.00	2.34	− 15.31	7.84	1.26	4.44	0.3154
MSCI World Excluding US	0.97	3.18	4.28	1.32	− 13.61	12.90	0.43	1.41	0.0999
F&F SMB factor	− 0.16	− 0.48	4.74	− 0.45	− 16.69	21.49	− 0.61	− 1.82	− 0.1294
F&F HML factor	0.00	− 0.02	3.61	0.10	− 9.05	12.03	− 0.41	− 1.61	− 0.1147
F&F HML International factor	0.28	1.28	3.04	0.12	− 12.75	7.92	− 0.19	− 0.87	− 0.0622
Momentum factor	1.15	3.70	4.39	1.03	− 10.93	13.88	0.81	2.58	0.1835
Bond									
Lehman US Aggregate	− 0.12	− 1.41	1.19	− 0.02	− 2.73	3.87	− 0.54	− 6.32	− 0.4489
Salomon World Government	0.45	3.64	1.72	0.27	− 3.43	5.94	0.05	0.38	0.0270
JPM Emerging Market Bond Index	0.97	2.64	5.15	1.68	− 21.98	10.55	0.52	1.41	0.1001
Lehman BAA Corporate	0.52	4.86	1.51	0.55	− 3.12	4.80	0.13	1.18	0.0842
Commodity									
Glodman Sachs Commodity	0.75	2.06	5.14	0.95	− 12.28	15.79	0.26	0.71	0.0503

This table shows the inception date, mean returns, *t*-stat for mean = 0, standard deviation, medians, minimum, maximum, mean excess returns, *t*-stat for mean excess return = 0, and Sharpe ratios for the individual hedge funds in our combined MAR/HFR database following 12 strategies and 15 sub-strategies, and for 11 passive investment strategies for the 1/1994 and 6/2000 period. Sharpe ratio is the ratio of excess return and standard deviation. In Panel A, no. of funds represent the number of funds following a particular strategy (or sub-strategy), living funds and dead funds represent the number of surviving and dead funds (in June 2000, without considering the new funds established in 6/2000). We calculate the mean excess return and the Sharpe ratio considering Ibbotson Associates 1-month T-bills. Numbers in the table are monthly percentages.

Table 4
Correlation between hedge funds, hedge funds and passive investment strategies, and between passive investment strategies

Panel A: Correlation between hedge funds strategies

	EVT	GLB	MAC	MKN	SHS	OPP	LOL	MKT	ENH	FEX	SEC	FOF	NCL	ALL
EVT	1.00													
GLB	0.74	1.00												
MAC	0.85	0.74	1.00											
MKN	0.83	0.82	0.89	1.00										
SHS	−0.70	−0.46	−0.73	−0.60	1.00									
OPP	0.85	0.74	0.95	0.84	−0.80	1.00								
LOL	0.85	0.78	0.91	0.87	−0.71	0.91	1.00							
MKT	0.27	0.17	0.44	0.31	−0.22	0.39	0.31	1.00						
ENH	0.86	0.76	0.94	0.83	−0.78	0.97	0.88	0.43	1.00					
FEX	0.77	0.69	0.61	0.71	−0.51	0.62	0.65	0.15	0.65	1.00				
SEC	0.87	0.77	0.94	0.85	−0.78	0.95	0.90	0.42	0.95	0.66	1.00			
FOF	0.83	0.92	0.88	0.95	−0.58	0.84	0.89	0.26	0.83	0.72	0.86	1.00		
NCL	0.10	0.13	0.38	0.35	−0.30	0.35	0.29	0.27	0.26	−0.15	0.30	0.25	1.00	
ALL	0.89	0.87	0.96	0.94	−0.71	0.95	0.93	0.38	0.94	0.71	0.95	0.95	0.32	1.00

Panel B: Correlation between hedge funds strategies and passive investments strategies

	EVT	GLB	MAC	MKN	SHS	OPP	LOL	MKT	ENH	FEX	SEC	FOF	NCL	ALL
MKT	0.69	0.64	0.72	0.58	−0.54	0.77	0.67	0.39	0.82	0.58	0.71	0.65	0.10	0.73
WXU	0.13	0.29	0.10	0.25	0.04	0.06	0.18	−0.19	0.05	0.26	0.06	0.27	−0.07	0.16
SMB	0.54	0.36	0.57	0.55	−0.65	0.57	0.58	0.20	0.52	0.31	0.63	0.47	0.27	0.56
HML	−0.32	−0.31	−0.45	−0.31	0.49	−0.48	−0.41	−0.30	−0.53	−0.32	−0.48	−0.32	0.00	−0.43
IHML	−0.14	−0.05	−0.31	−0.26	0.34	−0.31	−0.30	−0.17	−0.21	−0.02	−0.30	−0.17	−0.29	−0.24
MOM	0.14	0.05	0.29	0.24	−0.35	0.25	0.29	0.28	0.18	0.03	0.26	0.18	0.20	0.23
LUS	0.09	−0.05	0.06	−0.03	−0.06	0.06	0.09	0.05	0.06	0.02	0.04	−0.01	0.02	0.02
SWG	0.02	−0.23	0.00	−0.12	−0.12	0.05	0.00	0.20	0.08	−0.10	0.04	−0.19	0.01	−0.06
MEM	0.20	0.31	0.16	0.24	−0.01	0.11	0.25	−0.18	0.09	0.35	0.08	0.30	−0.16	0.20
BAA	0.66	0.55	0.49	0.58	−0.40	0.51	0.56	0.19	0.54	0.86	0.53	0.57	−0.13	0.58
GSC	0.35	0.18	0.31	0.32	−0.27	0.28	0.34	0.15	0.31	0.39	0.31	0.25	0.03	0.30

Panel C: Correlation between passive investment strategies

	MKT	WXU	SMB	HML	IHML	MOM	LUS	SWG	MEM	BAA	GSC
MKT	1.00										
WXU	−0.10	1.00									
SMB	−0.43	0.02	−0.28	1.00							
HML	−0.05	0.23	−0.38	0.08	1.00						
IHML	0.08	−0.23	0.31	−0.14	−0.52	1.00					
MOM	0.13	0.04	−0.04	0.06	−0.06	0.04	1.00				
LUS	0.13	−0.30	−0.10	−0.07	0.03	0.14	0.38	1.00			
SWG	−0.01	0.46	0.06	0.06	0.15	−0.12	0.24	−0.15	1.00		
MEM	0.45	0.19	0.20	−0.27	0.00	−0.01	0.15	0.04	0.23	1.00	
BAA	0.44	−0.03	−0.03	−0.06	−0.10	0.22	0.19	0.38	−0.01	0.43	1.00
GSC											

This table reports the correlation coefficient between hedge funds strategies (Panel A), between hedge funds strategies and passive investment strategies (Panel B), and between passive investment strategies for the January 1994–June 2000 period. EVT = Event Driven, GLB = Global, MAC = Global Macro, MKN = Market Neutral, SHS = Short Selling, OPP = US Opportunistics, LOL = Long Only Leveraged, MKT = Market Timing, ENH = Equity non-Hedge, FEX = Foreign Exchange, SEC = Sector, FOF = Funds of Funds, NCL = Non-Classified, ALL = All hedge funds, MKT = Market Proxy, WXU = World excluding US, IHML = International HML, MOM = Momentum, LUS = Lehman US Aggregate Bond Index, SWG = Salomon World Government Bond Index, MEM = JP Morgan Emerging Market Bond Index, BAA = Lehman BAA Corporate Bond Index, and GSC = Goldman Sachs Commodity Index.

The Sharpe ratio obtained by our whole hedge fund database (0.1596) is lower than the one for the Market Proxy (0.3154), and higher than for the MSCI World Excluding US (0.0999).

5.4. Correlation

Fung and Hsieh (1997), Schneeweis and Spurgin (1997), Liang (1999), and Amin and Kat (2001) report a weak correlation between hedge funds and other securities. Hence, the addition of hedge funds to a traditional portfolio should improve its risk-return trade-off.

Table 4 reports correlation coefficients among and between hedge funds and passive investment strategies.

Panel A reports correlations among hedge funds strategies. There is a high variability between different strategies, ranging from 0.97 (between Equity non-Hedge and US Opportunistics) to −0.80 (between Short Selling and US Opportunistics). Thirty-nine correlation coefficients (40%) are greater than 0.80 and 14 (14%) are negative. In particular, Short Sellers are negatively correlated with all the other hedge fund strategies.

Panel B reports correlation coefficients between hedge funds and equity, bond and commodity indices. The range is narrower than in the previous case (from −0.65 to 0.86). Correlation coefficients between hedge funds strategies and the Market Proxy are, in almost all cases, greater than 0.5 whereas they are always smaller than 0.3 with the MSCI World excluding US and than 0.5 with bond indices (except for the default factor). These results confirm that hedge funds strategies are weakly correlated with traditional investment tools.[13]

Panel C displays correlations among passive investment strategies. All coefficients are below 0.46 (and higher than −0.53) and almost 90% of them are below 0.3, too low to raise serious multicolinearity concerns.

6. Hedge funds performance

The aim of this section is to determine whether or not hedge funds as a whole and depending on the strategy followed have out-performed the market. We compute all estimations by using Newey and West (1987) standard errors to adjust for any autocorrelation in the returns.

Following the discussion of the previous section, the discussion of performance models will be performed on the 1994–2000 period, when the database can be considered as fully reliable.

6.1. Performance measurement using the CAPM

The first performance model used is the CAPM based single index model. Panel A of Table 5 reports the results for the strategies, sub-strategies and for the All Funds category.

[13] Except with the market proxy, but this result can easily be understood since the market proxy contains almost all the American market.

Table 5
Performance measurement using the CAPM, Carhart's four-factor model and the combined model

	Panel A: Single index model							Panel B: Carhart's four-factor model								
	Alpha	Mkt	R^2_{adj}	No. of funds	Alpha distrib., +/0/−			Alpha	Mkt	SMB	HML	PR1YR	R^2_{adj}	No. of funds	Alpha distrib., +/0/−	
Event Driven	0.35%**	0.42***	0.57	84	25%	73%	2%	0.43%***	0.44***	0.24***	0.11***	−0.06***	0.78	84	27%	69%	4%
Distressed Sec.	0.10%	0.39***	0.43	37	11%	89%	0%	0.24%	0.42***	0.29***	0.14***	−0.11***	0.70	37	14%	81%	5%
Risk Arbitrage	0.55%***	0.45***	0.53	38	42%	53%	5%	0.62%***	0.46***	0.22***	0.09***	−0.04*	0.68	38	42%	55%	3%
No Sub-strategy	0.18%	0.42***	0.40	9	11%	89%	0%	0.08%	0.41***	0.14***	0.08	0.11***	0.50	9	22%	78%	0%
Global	−0.13%	0.62***	0.45	258	12%	86%	3%	0.03%	0.63***	0.26***	0.10	−0.12**	0.53	258	14%	84%	3%
International	−0.03%	0.54***	0.54	50	10%	90%	0%	0.10%	0.54***	0.21***	0.06	−0.09***	0.63	50	10%	88%	2%
Emerging	−0.26%	0.67***	0.38	151	9%	87%	4%	−0.07%	0.68***	0.29***	0.09	−0.14*	0.45	151	11%	87%	3%
Regional Est.	0.43%**	0.44***	0.53	57	19%	79%	2%	0.53%***	0.44***	0.21***	0.07	−0.06*	0.66	57	25%	72%	4%
Global Macro	0.62%***	0.55***	0.62	252	23%	75%	2%	0.67%***	0.51***	0.27***	0.03	0.03	0.83	252	31%	68%	2%
Market Neutral	0.40%***	0.21***	0.42	553	33%	66%	1%	0.42%***	0.21***	0.14***	0.05*	0.00	0.64	553	37%	62%	1%
Long/Short	0.72%***	0.16***	0.26	102	34%	64%	2%	0.71%***	0.17***	0.15***	0.10***	0.01	0.59	102	36%	63%	1%
Convertible Arb.	0.41%***	0.06***	0.08	39	74%	26%	0%	0.45%***	0.08***	0.06***	0.06***	−0.04***	0.20	39	77%	23%	0%
Fixed Income	−0.08%	0.39***	0.43	48	10%	88%	2%	0.02%	0.33***	0.16***	−0.08	−0.01	0.53	48	8%	92%	0%
Stock Arbitrage	0.38%***	0.24***	0.38	310	31%	68%	1%	0.41%***	0.24***	0.17***	0.06*	0.00	0.59	310	38%	61%	1%
Mortgage-Backed	0.35%***	0.07***	0.06	46	28%	70%	2%	0.29%***	0.08***	0.01	0.04	0.04**	0.07	46	30%	67%	2%
Rel. Value Arb.	0.51%**	0.20***	0.19	8	50%	50%	0%	0.59%***	0.24***	0.12*	0.15**	−0.05	0.21	8	50%	50%	0%
Short Sellers	0.86%***	−0.48***	0.39	18	28%	72%	0%	0.77%***	−0.38***	−0.35***	0.07	−0.07*	0.72	18	17%	83%	0%
US Opport.	0.50%***	0.80***	0.70	180	19%	81%	1%	0.63%***	0.75***	0.38***	0.02	0.00	0.90	180	31%	68%	2%
Growth	0.60%***	0.96***	0.65	68	24%	76%	0%	0.78%***	0.83***	0.43***	−0.11	0.04	0.86	68	38%	60%	1%
Value	0.36%**	0.70***	0.74	100	14%	85%	1%	0.46%***	0.70***	0.29***	0.11***	−0.05*	0.88	100	24%	74%	2%
Small Caps	1.39%***	0.66***	0.35	12	33%	67%	0%	1.57%***	0.64***	0.55***	0.14*	−0.06	0.64	12	42%	58%	0%
Long Only Lev.	0.17%	0.96***	0.54	18	11%	83%	6%	0.25%	0.90***	0.54***	0.11	0.06	0.77	18	17%	78%	6%
Market Timing	0.47%***	0.18***	0.14	34	26%	74%	0%	0.43%***	0.14***	0.03	−0.06	0.09*	0.18	34	18%	82%	0%
Equity non-Hed.	0.24%	0.86***	0.77	112	9%	89%	2%	0.44%***	0.80***	0.35***	−0.03	−0.06***	0.93	112	19%	80%	1%
Foreign Exch.	0.01%	0.19***	0.37	9	0%	67%	33%	0.07%	0.19***	0.08***	0.01	−0.04***	0.42	9	11%	89%	0%
Sector	0.68%***	0.69***	0.62	128	30%	67%	2%	0.82%***	0.63***	0.40***	0.01	0.00	0.89	128	41%	59%	0%
Funds of Funds	−0.07%	0.37***	0.49	278	13%	83%	4%	−0.02%	0.37***	0.19***	0.08*	−0.02	0.63	278	20%	77%	3%
Non Classified	4.83%***	0.08	0.01	230	13%	86%	0%	4.76%***	0.09	0.12	0.10	0.06	0.06	230	43%	55%	2%
All funds	0.36%**	0.44***	0.64	2154	24%	74%	2%	0.43%***	0.42***	0.23***	0.04	−0.01	0.84	2154	30%	69%	2%
		Mean R^2_{adj}	0.44	Mean	23%	74%	3%					Mean R^2_{adj}	0.60	Mean	28%	70%	2%

Panel C: The combined model

	Alpha	Mkt	Wd × US	SMB	HML	I HML	PR1YR	US Bd	World GV Bd	Emerg Bd	Default	Comm.	R^2_{adj}	No. of funds	Alpha distrib.		+/0/−
Event Driven	0.34%*	0.42***	0.01	0.25***	0.10***	0.050	−0.034	−0.04	−0.012	0.0631***	0.11*	0.00	0.79	84	27%	69%	4%
Distressed Sec.	0.09%	0.40***	0.06	0.27***	0.12***	0.041	−0.075**	−0.075	−0.029	0.071**	0.16**	0.00	0.74	37	19%	78%	3%
Risk Arbitrage	0.60%***	0.44***	−0.03	0.24***	0.08***	0.065	−0.024	0.0085	−0.092	0.0504*	0.13	−0.01	0.66	38	39%	55%	5%
No Sub-strategy	−0.05%	0.43***	0.00	0.16***	0.10	0.048	0.1239***	−0.095	0.3855***	0.0639	−0.16	0.00	0.51	9	11%	89%	0%
Global	−0.50%	0.68***	0.12*	0.16***	0.07	0.036	0.0057	−0.327*	−0.408***	0.1278***	−0.12	0.09**	0.67	258	10%	77%	12%
International	−0.21%	0.56***	0.13**	0.13***	0.03	−0.047	−0.02	−0.172	−0.205*	0.0636*	−0.05	0.08***	0.72	50	10%	82%	8%
Emerging	−0.71%	0.73***	0.13*	0.17***	0.06	0.062	0.0182	−0.382*	−0.482***	0.1624***	−0.17	0.12**	0.60	151	8%	75%	17%
Regional Est.	0.27%	0.50***	0.10**	0.18***	0.09*	−0.024	−0.028	−0.218**	−0.091	0.0325	−0.16*	−0.03	0.71	57	18%	77%	5%
Global Macro	0.56%***	0.53***	0.06*	0.25***	0.04	−0.086*	0.0295	−0.111	0.0142	0.064***	−0.06	−0.02	0.85	252	42%	56%	1%
Market Neutral	0.28%***	0.21***	0.07***	0.11***	0.04**	−0.037	0.018	−0.15***	−0.063	0.0262	0.07	0.01	0.72	553	30%	65%	5%
Long/Short	0.67%***	0.16***	0.01	0.13***	0.08***	−0.072***	−0.004	−0.117*	−0.049	0.0178	0.10*	0.02*	0.61	102	27%	71%	2%
Convertible Arb.	0.42%***	0.05***	0.05**	0.05***	0.04**	0.022	−0.024*	0.0587	−0.113***	0.0295*	0.16***	0.00	0.49	39	59%	41%	0%
Fixed Income	−0.26%	0.36***	0.09*	0.13***	−0.07*	0.040	0.0527*	−0.167	−0.021	0.0422	−0.09	0.02	0.55	48	8%	79%	13%
Stock Arbitrage	0.22%*	0.25***	0.09***	0.13***	0.06**	−0.052	0.0213	−0.19***	−0.077	0.0248	0.04	0.01	0.68	310	29%	65%	6%
Mortgage-Backed	0.23%	0.02	0.02	0.02	0.01	0.009	0.0368*	−0.126*	−0.005	0.0281	0.33***	0.00	0.22	46	33%	63%	4%
Rel. Value Arb.	0.43%	0.21***	0.03	0.02	0.02	0.076	0.023	0.029	−0.23*	0.101**	0.05	0.05*	0.36	8	50%	38%	13%
Short Sellers	0.75%***	−0.34***	0.01	−0.31***	0.10	0.072	−0.053	0.0507	−0.14	−0.01	−0.07	−0.08**	0.72	18	44%	56%	0%
US Opport.	0.46%***	0.80***	0.09**	0.32***	0.04	−0.164**	−0.002	−0.184*	0.178**	0.0394*	−0.29**	0.02	0.92	180	21%	76%	3%
Growth	0.74%***	0.85***	0.04	0.36***	−0.12	−0.345***	−0.031	−0.214	0.1489	0.1026***	−0.18	0.00	0.89	68	28%	72%	0%
Value	0.20%	0.77***	0.12***	0.26***	0.13***	0.018	0.012	−0.121	0.1981***	−0.002	−0.34***	0.04**	0.91	100	16%	79%	5%
Small Caps	1.34%***	0.73***	0.08	0.46***	0.16**	−0.245***	−0.064	−0.27	0.144	0.0534	−0.51**	0.06	0.65	12	25%	75%	0%
Long Only Lev.	0.00%	0.88***	0.14*	0.47***	0.07	−0.14	0.0787	−0.166	0.0043	0.1882***	0.17	−0.01	0.82	18	17%	78%	6%
Market Timing	0.48%**	0.19***	0.02	0.09***	0.00	0.036	0.0631	0.0239	0.2132*	−0.052	−0.16	−0.12**	0.25	34	12%	88%	0%
Equity non− Hed.	0.23%*	0.84***	0.08**	0.31***	−0.02	−0.065	−0.045*	−0.201**	0.2109***	0.028	−0.21***	0.04*	0.94	112	28%	71%	1%
Foreign Exch.	−0.02%	0.15***	0.00	0.07***	−0.01	0.027	−0.031	−0.098*	−0.112	0.0801***	0.23***	−0.01	0.56	9	0%	78%	22%
Sector	0.69%***	0.63***	0.06*	0.37***	0.00	−0.079	−0.004	−0.176	0.0636	0.0211	0.01	0.03	0.89	128	30%	69%	2%
Funds of Funds	−0.28%*	0.39***	0.07*	0.14***	0.06*	−0.007	0.0356	−0.178*	−0.202**	0.0768***	−0.01	0.04*	0.75	278	14%	72%	14%
Non Classified	4.86%***	0.14	0.10	0.11***	0.14	−0.126	0.027	0.0641	0.0828	−0.12***	−0.20	−0.04	0.05	230	35%	62%	3%
All funds	0.25%**	0.44***	0.06**	0.19***	0.04*	−0.039	0.0109	−0.159**	−0.053	0.048***	−0.03	0.01	0.88	2154	26%	68%	6%
												Mean R^2_{adj}	0.66	Mean	25%	70%	5%

This table presents the results of the estimation of the single index model (Panel A) of Carhart's (1997) model (Panel B) and of our combined model (Panel C) for the 1/1994 – 6/2000 period. We report the OLS estimators for equally weighted portfolio's per investment strategy, sub-strategy, and for all funds. The last column gives the distribution of individually estimated monthly alphas for all funds with 24 monthly data or more in a specific investment style. We report the percentage of significantly positive alpha's (+), significantly negative alpha's (−), and alpha's that are insignificantly different from zero (0) at the 5% level. The next to last column reports the number of individual funds used for the individual estimation of the last column. *t*-stats are heteroskdasticity consistent.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

We use equally weighted portfolio excess returns for each investment style and for the All Funds category, and we estimate the model for each fund individually.[14] The last columns give the distribution of individually estimated alphas per strategy, with the percentage of significantly positive, insignificant and negative alphas at the 5% level. This approach enables us to analyze hedge funds performance in more details.

The betas estimated in Panel A are rather low, except for US Opportunistics Growth and the Long Only Leveraged, suggesting the need to use a more detailed model. Overall, two thirds of the strategies produce significantly positive alphas. The All Funds category also significantly out-performs the market at the 1% level. In almost all out-performing strategies, more than 30% of the alphas are significant. Surprisingly, for some strategies (e.g. Equity non-Hedge or the Non Classified funds), more than 80% of the individual funds do not significantly out-perform the market, inducing that the best funds must have obtained extremely high returns.[15]

6.2. Performance measurement using multi-factor models

It is presumably better to use a multi-factor model to account for all possible investment strategies. In Panel B of Table 5, we report the results for Carhart's four-factor model and in Panel C the results for our combined model applied to hedge funds.[16]

Panels B and C reveal that the premium on the SMB factor is, in almost all cases, significantly positive. However, in the Short Sellers strategy, the premium is significantly negative. Panel C shows that the HML (respectively IHML) factor seems to add less explanatory power as only one third (respectively one seventh) of the factors is significantly positive at the 5% level. The Momentum factor does not prove to be a strong indicator of hedge funds behavior. Only 6 out of 28 investment styles exhibit significant momentum loadings (at the 10% level). Moreover, the sign of the coefficient is in three cases negative, indicating momentum contrarian strategies.

Panel C also indicates that the World excluding US, US Bond, Default, World Government Bond, and Commodity factors add explanatory power in 20–33% of the cases. The Default factor has, as we can expect, a negative impact in half of the cases. The Emerging Bond factor adds explanatory power in 16 of the strategies and sub-strategies. It is highly significant (at the 1% level) in more than half of the strategies, as well as for the All Funds category.

These results provide some insight into the preferences of hedge funds managers depending on the strategy followed:

- Almost all managers seem to prefer smaller stocks;
- Most Event Driven, Market Neutral and US Opportunistics managers prefer stocks with high book-to-market ratios;

[14] To make individual estimation, we require all funds to have consecutive monthly return history for at least 24 months, so that relatively accurate risk measures can be estimated.

[15] These results are remarkably similar to the 1984–1993 period (data available upon request).

[16] The Fama and French (1993) model produces results very similar to the Carhart model.

- Some Event Driven and Market Neutral managers follow a momentum strategy and others are momentum contrarian;
- More than half of the managers invest in emerging bond markets.

These results are close to those found by Mitchell and Pulvino (2001) and Agarwal (2001) for the funds following Event Driven strategies. We find that 27% of the hedge funds show significant excess return, matching the 27% they found. This independently confirms that our approach is able to capture important risk exposure of hedge funds.

Table 6
Performance of hedge funds in different subperiods

	1 subperiod	2 subperiods		Asian crisis		Pre-1994
	1/1994–6/2000	1/1994–12/1996	1/1997–6/2000	1/1997–12/1998	1/1997–6/1998	*1/1984–12/1993*
Event Driven	0.34%*	0.41%*	0.08%	0.02%	−0.05%	*−0.21%*
Distressed Sec.	0.09%	0.17%	−0.11%	0.19%	−0.07%	*0.07%*
Risk Arbitrage	0.60%***	0.60%**	0.31%*	−0.13%	0.02%	*−0.29%*
No Sub-strategy	−0.05%	0.40%	−0.45%	−0.17%	−0.25%	*−0.53%***
Global	−0.50%	0.23%	−1.21%***	−1.02%	−1.30%**	*1.01%**
International	−0.21%	−0.33%	−0.40%	−0.99%***	−1.10%***	*1.29%****
Emerging	−0.71%	0.47%	−1.70%***	−1.18%	−1.55%**	*0.92%*
Regional Est.	0.27%	0.38%***	−0.07%	−0.46%	−0.54%	*1.21%****
Global Macro	0.56%***	0.45%*	0.56%***	0.46%	−0.07%	*0.85%****
Market Neutral	0.28%***	0.20%	0.19%**	0.15%	−0.04%	*0.63%****
Long/Short	0.67%***	0.40%*	0.72%***	0.66%***	0.42%**	*0.05%*
Convertible Arb.	0.42%***	0.46%***	0.36%***	0.40%***	0.40%***	*0.55%****
Fixed Income	−0.26%	−0.47%	−0.41%	−0.72%	−1.23%**	*1.01%****
Stock Arbitrage	0.22%*	0.16%	0.13%	0.08%	−0.11%	*0.81%****
Mortgage-Backed	0.23%	0.58%***	−0.17%	−0.13%	−0.12%	*0.00%*
Rel. Value Arb.	0.43%	1.20%***	0.26%	0.54%	1.20%***	*NA*
Short Sellers	0.75%***	0.70%	0.51%	0.66%**	0.48%	*0.13%*
US Opport.	0.46%***	0.57%***	0.41%**	0.40%	−0.05%	*0.73%****
Growth	0.74%***	0.94%***	0.64%**	0.65%**	0.19%	*1.13%****
Value	0.20%	0.26%*	0.19%	0.21%	−0.18%	*0.47%***
Small Caps	1.34%***	2.56%***	0.60%*	0.44%	−0.23%	*1.70%*
Long Only Lev.	0.00%	0.28%	−0.21%	−0.20%	−0.42%	*NA*
Market Timing	0.48%**	0.10%	0.49%	0.22%	0.23%	*0.22%*
Equity non-Hed.	0.23%*	0.52%**	0.07%	0.04%	−0.33%	*0.06%*
Foreign Exch.	−0.02%	0.20%	−0.25%	0.13%	0.39%***	*0.83%****
Sector	0.69%***	0.77%***	0.55%*	0.42%*	0.16%	*1.10%***
Funds of Funds	−0.28%*	−0.28%	−0.43%**	−0.33%	−0.48%**	*0.61%****
Non Classified	4.86%***	4.14%***	5.57%***	4.38%***	3.79%***	*3.84%****
All funds	0.25%**	0.29%*	0.10%	0.04%	−0.24%	*0.64%****

This table reports a summary of the results for the estimation of the combined model for different time periods. We report monthly alphas for equally weighted portfolio's per investment strategies, sub-strategies, and for all funds. NA means that we could not make the estimation for the subperiod considered because the strategy has existed for less than 24 months. *t*-stats (not reported) are heteroskedasticity consistent.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table 7
Hedge funds persistence based on 12-month lagged returns

	Monthly Exc. return	Std. Dev.	Alpha	Mkt	Wd × US	SMB	HML	IHML	PR1YR	US Bd	World GV Bd	Emerg Bd	Default	Com.	R^2_{adj}
D1a	1.68%	6.69%	0.08%	0.74***	0.05	0.66***	−0.03	−0.32	0.19	−0.93**	−0.19	0.12	0.44	0.13	0.74
D1b	1.26%	4.84%	0.15%	0.62***	0.12	0.40***	−0.14	−0.29***	0.14*	−0.38	0.02	0.05	0.09	0.11**	0.81
D1c	1.11%	3.98%	0.22%	0.55***	0.08	0.39***	−0.02	−0.18	0.10	−0.30	−0.18	0.03	0.02	0.03	0.79
D1	1.35%	5.09%	0.15%	0.64***	0.09	0.48***	−0.07	−0.26*	0.14	−0.54*	−0.12	0.07	0.18	0.09	0.79
D2	0.89%	3.47%	−0.10%	0.55***	0.10	0.33***	0.05	−0.12*	0.09**	−0.38**	−0.09	0.06	0.00	0.06**	0.85
D3	0.83%	2.52%	0.13%	0.50***	0.05	0.24***	0.10**	−0.05	0.03	−0.14	0.03	0.03	−0.02	0.01	0.88
D4	0.82%	2.18%	0.18%	0.47***	0.06**	0.17***	0.09***	0.01	−0.01	−0.09	0.00	0.03	−0.06	0.01	0.87
D5	0.71%	1.90%	0.08%	0.40***	0.05*	0.13***	0.09***	−0.01	0.00	−0.22***	−0.07	0.07***	−0.04	0.01	0.84
D6	0.57%	1.61%	0.11%	0.32***	0.06**	0.13***	0.09***	0.01	−0.03	−0.11	−0.04	0.05**	0.07	0.00	0.82
D7	0.62%	1.58%	0.23%*	0.33***	0.03	0.12***	0.07**	0.00	−0.05*	−0.05	−0.01	0.05**	0.04	−0.01	0.80
D8	0.57%	1.78%	0.10%	0.36***	0.06*	0.13***	0.04	0.06	−0.03	−0.06	−0.08	0.04	−0.02	−0.01	0.75
D9	0.80%	1.92%	0.34**%	0.38***	0.06	0.09***	0.00	0.03	−0.05	−0.07	−0.07	0.03	−0.12	−0.01	0.65
D10	0.89%	2.92%	0.24%	0.50***	0.07	0.04	−0.05	0.08	−0.02	−0.05	−0.09	0.06	−0.37*	0.00	0.44
D10a	0.82%	2.62%	0.13%	0.48***	0.03	0.09**	−0.05	0.15	−0.02	−0.12	−0.11	0.09*	−0.16	0.00	0.61
D10b	0.84%	3.00%	0.15%	0.54***	0.05	0.05	0.01	0.07	−0.01	−0.02	−0.06	0.09*	−0.34	0.01	0.44
D10c	1.03%	3.80%	0.44%	0.51***	0.14	−0.03	−0.12	0.02	−0.04	−0.01	−0.11	0.01	−0.63*	−0.01	0.22
1–10 spread	0.45%	4.62%	−0.09%	0.13	0.02	0.45***	−0.01	−0.35**	0.16	−0.49	−0.03	0.00	0.55*	0.09	0.52
1a–10c spread	0.65%	6.91%	−0.36%	0.24	−0.09	0.70***	0.09	−0.34	0.23	−0.92*	−0.07	0.11	1.06**	0.14	0.48
1–2 spread	0.46%**	2.09%	0.25%	0.08	−0.01	0.15***	−0.11*	−0.14	0.05	−0.15	−0.03	0.01	0.18	0.03	0.43
9–10 spread	−0.10%	1.54%	0.10%	−0.12*	−0.01	0.05	0.06	−0.05	−0.03	−0.01	0.02	−0.03	0.24*	−0.01	0.04

Carhart (1997) and Gruber (1996) examine US mutual fund strategies and report that managers prefer smaller stocks as well as growth stocks. The first evidence is consistent with our finding, while the second one is opposite. However, this difference does not exist for all hedge funds managers, given that the HML factor is only significant for some strategies.

Comparing the alpha distribution of Panels B and C shows that taking more factors into account induces that fewer individual funds significantly out-performed the market, and more funds have insignificant or negative excess returns.

Evidence on alphas obtained in Panel C is contrasted. The excess returns for Event Driven, Global, Long Only Leveraged, Equity non-Hedge, and Foreign Exchange strategies are insignificant (at the 5% level), whereas the alpha for the Fund of Funds strategy is negative and significant. All other categories display positive and significant alphas. Our results are in most cases confirmed by the last column. In the All Funds category, for example, more than 25% of the individual alpha's are significantly positive at the 5% level.

Considering the All Funds category, we can observe that hedge funds as a whole:

- Deliver significant excess returns (one fourth of the individual funds gave significant positive excess return);
- Seem to prefer smaller stocks;
- Invest in emerging market bonds and suffer from the US bond market.

Overall, it seems that the combined model does a very good job in describing hedge funds behavior. The average R^2_{adj} increases from 0.44 for the single-factor model, to 0.60 for the four-factor model and to 0.66 for our combined model. The combined model gives adjusted R^2 higher than 0.65 for all strategies but the Market Timing (0.25), the Non-Classified funds (0.05), and Foreign Exchange funds (0.56). It seems particularly adapted to Equity non-Hedge (0.94), US Opportunistics (0.92), Sector (0.89), Global Macro (0.85), Long Only Leveraged (0.82), and Event Driven funds (0.79). The R^2_{adj} for the All Funds category increases from 0.66 for the single-factor model, to 0.84 for the four-factor model and to 0.88 for our combined model. The mean R^2_{adj} for the individual hedge funds estimation is up too. Carhart's (1997) model raises the R^2_{adj} by an average 10% over the

Notes to Table 7:

This table reports the result of the estimation of our combined model for the 1/1994–6/2000 subperiod. Each year, all funds are ranked based on their previous year's return. Portfolios are equally weighted and weights are readjusted whenever a fund disappears. Funds with the highest previous year's return go into portfolio D1 and funds with the lowest go into portfolio D10. Monthly Exc. Return is the monthly excess return of the portfolio, Std. Dev. is the standard deviation of the monthly excess return. Mkt is the excess return on the market proxy. SMB, HML, IHML, PR1YR, W × US, US Bd, W Gvt BD, Emerg Mkt BD, Default and Comm. are factors added to adjust for size, book-to-market, 1-year return momentum and for the fact that some funds invest in other than US equity market, in bonds not picked up by the risk-free rate or in commodities. All numbers in the table are monthly percentages.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

single index model, but our combined model increases it again by another 7%. For the All Funds category, the increase from the CAPM to Carhart's model is 10% and from Carhart's model to our combined model is another 7%.

Our R^2_{adj} are also higher than those obtained by Brown, Goetzmann, Hiraki, Otzuki and Shiraishi (2001) and Brown, Goetzmann and Park (2001) and Fung and Hsieh (1997). They report R^2 lower than 0.20 in all cases for groups of funds. Schneeweis and Spurgin (1997) report R^2_{adj} between -0.09 and 0.67 with a mean of 0.31 for several hedge funds strategies. Comparing their results with ours for strategies that exist across the two databases, we get greater R^2_{adj} in all cases. For several HFR strategies, Liang (1999) finds unadjusted coefficients ranging from 0.23 to 0.77, with an average of 0.49: taking the same strategies, our R^2_{adj} range between 0.27 and 0.92 with an average of 0.63.

6.3. Performance over shorter periods

In the previous subsections, we discuss the performance of hedge funds using several specifications for the 1/1994–6/2000 period. In order to better interpret these results, Table 6 presents a summary of the same analysis over different subperiods. We subdivide the 1994–2000 period in two subperiods of equal lengths, and then report results of the same analysis for the Asian crisis period. The analysis of the Asian crisis period will enable us to determine if some strategies took advantage of the crisis and which one suffered (or not) from it. The 1984–1993 period is reported in the last column for comparison purposes.

The last column of Table 6 confirm that the same strategies significantly out-perform the market when the period before 1994 is considered, with only 4 exceptions. Three strategies (Short Sellers, Market Timing, and Equity non-Hedge) do not beat the market in the 1984–1993 period but do after 1994, while one (Foreign Exchange) does the reverse.

When the time period is divided in two, it is interesting to note that the significance of the abnormal performance for the 1994–2000 period is mainly due to the first subperiod; some hedge funds strategies and sub-strategies even significantly under-perform the market in the second subperiod (Global, Emerging, Funds of Funds). The latter is the only one whose significant under-performance extends to the whole 1994–2000 time window.

A closer look at the 1997–1998 suggests that most hedge funds strategies suffered during the Asian crisis. Nineteen strategies and sub-strategies out of the 29 face negative returns between 1997 and the middle of 1998, with five being significant (Global, Global International, Global Emerging, Market Neutral Fixed Income, and Funds of Funds). Five strategies had significant positive returns during this period (Market Neutral, Long/short, Convertible Arbitrage, Non Classified funds, Relative Value Arbitrage, and Foreign Exchange), but only the first three had also significant excess returns during other subperiods. The only sub-strategies that could have significantly benefited from the Asian crisis are the Relative Value Arbitrage and the Foreign Exchange. However, one must be cautious because of the short estimation period.

Moreover, the division in subperiods indicates that over-performance is rarely sustainable over every shorter period of time: three strategies (Long/Short, Convertible Arbitrage and the Non Classified funds) out-performed the market in all subperiods we considered; only the latter two extend their superior performance to the pre-1994 subperiod.

6.4. Comparison with other studies

Schneeweis and Spurgin (1997) and Liang (1999) find different results from Tables 5 and 6, but they are mainly due to differences in the period studied and to a smaller number of funds in their database.[17] Agarwal and Naik (2002) find the same results as ours except that Fixed Income, Risk Arbitrage and Long Only Leveraged strategies significantly under-performed the market on average, while we find only small percentages of under-performing funds. Finally, Agarwal (2001) finds results close to ours.

7. Persistence in performance

Our results show significant evidence of superior performance over long period of time for most individual strategies and sub-strategies. Nevertheless, results are not stable over shorter period of time, neither for hedge funds as a whole, nor for individual hedge funds. Active hedge funds selection strategies could increase the expected return on a portfolio if hedge fund performance is predictable. The hypothesis that hedge funds with a superior average return in this period will also have a superior average return in the next period is called the hypothesis of persistence in performance. Sirri and Tufano (1998) and Zheng (1999) stress the importance of persistence analysis in mutual funds. The former documents large inflows of money into last years' best performers, and withdrawals from last years' losers. The latter finds that newly invested money in these best performing mutual funds is a predictor of future performance.

7.1. Persistence in 1-year return-sorted hedge funds portfolios

We follow the methodology of Carhart (1997) using our combined model. All funds are ranked based on their previous year return. Every January, we put all funds into 10 equally weighted portfolios, ordered from highest to lowest past returns. Portfolios 1 (high) and 10 (low) are then further subdivided on the same measure. The portfolios are held till the following January and then rebalanced again. This yields a time series of monthly returns on each decile portfolio from 1/1994 to 6/2000.[18] Funds that disappear during the course of the year are included in the equally weighted average until their death, then portfolio weights are readjusted appropriately.

The monthly average return to the strategy of investing in portfolio 1 would have been 1.35% for the 1/1994–6/2000 period. Conversely, the monthly (respectively maximum and minimum) return to the strategy that invested in the lowest decile would have been 0.89% over the same period. For the 1985–1993 period, decile portfolios 1 and 10 have earned 1.74% and 1.07%, respectively.

[17] Liang (1999) finds insignificant positive excess return for the Convertible Arbitrage, Foreign Exchange, Funds of Funds, Market Timing, Sector and Short Selling strategies but documents that Growth and Market Neutral strategies significantly under-perform the market.

[18] The corresponding table for the 1985–1993 period is available upon request.

The monthly excess returns on the decile portfolios decrease monotonically between portfolio D1 and D6, but then increases again from portfolio D6 to portfolio D10. Monthly excess return of portfolio D2 is the same as the one of the last portfolio. The annualized spread is approximately 5.5% between portfolio D1 and D10. Portfolio D1a out-performs portfolio 10c by 0.65% per month. These spreads are not significant.[19] Cross-sectional variation in returns is considerably larger among previous year's best performing funds than previous year's worst funds. The sub-portfolios of the bottom decile show a modest spread of 21 basis point (0.82−1.03), whereas the spread in the top decile is a substantial 57 basis point (1.68−1.11). The 1−2 spread is significant at the 5% level, indicating big differences between top performing funds and other portfolio funds, but the 1−2 spread alpha is not significant, suggesting no persistence. After controlling for the risk factors, a large part of the spread between high and low portfolios disappears. The 1−10 spread goes from a 0.45% to −0.09%, the 1a and 10c spread decreases from 0.65% to −0.36%, still not significant, and the 1−2 spread reduces from a significant 0.46% to a 0.25% nonsignificant spread.

Column 7 suggests that all deciles portfolios (except the last) prefer small stocks. More important, however, is the pronounced pattern in the funds' HML, PR1YR and Emerging Market Bond coefficients (Emerg Bd). First, portfolio D3 to D7 prefer stocks with high book-to-market ratios, whereas portfolios D1 and D10 prefer (but not significantly) those with low book-to-market. Second, returns of the top decile funds are strongly, positively correlated with the 1-year momentum factor, while returns in the other deciles are not. Third, the returns of the D5 to D7 deciles are strongly, positively related with the Emerging Market Bond factor. This could explain why the monthly excess return diminishes after decile D3. Thus, the different financial crises covered by our time period may explain why funds investing in Emerging market Bond are not in the three best performing decile portfolios.

Column 4 suggests that funds in top and bottom portfolios do not significantly out- or under-perform the market, without persistence. This means that these funds are there more by luck or misfortune, rather than by their abilities. Moreover, the standard deviation of top and bottom deciles are the greatest of all, indicating more volatility in returns. Things are different for the funds in the middle deciles. Managers in these portfolios are more likely to stay in these deciles over time, and some of these managers significantly beat the market (deciles 7 and 9).[20]

This suggests that, even if some hedge funds managers take a lot of risk, which lead them to have very high or low returns for short period of time, most managers follow less risky strategies that allow them to out-perform the market for long period of time.

The stronger persistence for middle deciles with a substantially lower variance of returns than extreme deciles is in line with the conjecture of Brown, Goetzmann, Hiraki, Otsuki and Shiraishi (2001) and Brown, Goetzmann and Park (2001). Funds that

[19] Over the whole database, the D1−D10 and D1a−D10c spreads amount to 0.58% and 0.95%, respectively, both significant.

[20] These results are reinforced when one considers the global database and when we consider strategies individually (see Section 7.4). The qualitative results for the book-to-market and momentum strategies are unchanged, and evidence on an emerging bond market strategy for middle decile portfolios is stronger. Alphas are significantly positive for funds in deciles 3 to 7 and 9. However, these values are mainly driven by the extremely good performance funds belonging to those deciles in the 1985−1993 period, which raises a legitimate suspicion over their economic significance.

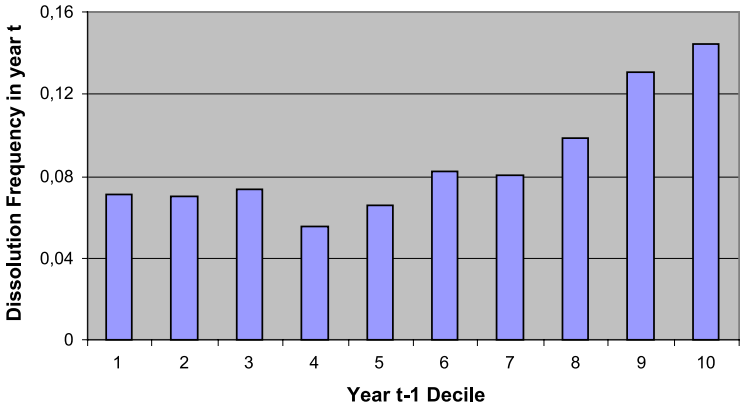

Fig. 2. Hedge funds dissolution frequencies by year t as a function of year $t-1$ decile. At the beginning of year t, all funds are placed into decile rankings on the basis of their returns in year $t-1$. If a hedge fund ceases to report returns at any time before the end of year t, it is counted as dissolved.

performed well—relative to the market, i.e. with a positive alpha—tend to pursue a low variance strategy. Extreme performers tend not to remain in their situation; this can be explained by dissolution or by the fact that they are more or less forced to take less risk, returning to the middle of the pack. Brown, Goetzmann, Hiraki, Otzuki and Shiraishi (2001) and Brown, Goetzmann and Park (2001) explain this behavior of funds managers by the negative penalty linked to dissolution having a relatively stronger effect than the reward of the call-like feature of their compensation contract.

To summarize, Table 7 leads to the following conclusions:

- Best performing funds follow momentum strategies whereas worst performing ones may follow momentum contrarian strategies;[21]
- Best performing funds do not invest significantly in emerging market bonds;
- Average return funds prefer high book-to-market stocks, whereas best and worst performing ones may prefer low book-to-market ones;
- No persistence in performance exists for best and worst performing funds, but there is weak evidence of persistence for middle deciles, where some funds significantly beat the market with persistence. Evidence is more pronounced for the 1985–1993 period, but it is likely to be driven by the absence of dissolved funds in this period.[22]

7.2. Persistence over the Asian crisis

The same analysis for the Asian crisis period shows that top performing funds of 1996 had significantly lower returns in 1997.[23] The alphas of decile D1 and the 1a–10c spread are

[21] This result may not be stable over time, since the period under study covers a bull market when momentum strategies are likely to work. After the strong market reversal that took place after March 2000 would be very indicative of the economic significance of this result, but our database unfortunately ends in June 2000. These issues are being investigated as a part of our ongoing research.

[22] But one must be cautious with this result, given that this is not the only reason possible. The Bond crisis in 1994, the Asian crisis in 1997–1998, etc., may also explain these differences.

[23] Numerical results are available upon request.

Table 8
Hedge funds strategy persistence based on 12-month lagged returns

Panel A: Global Macro

	Asian crisis											
	1994–2000			1997–6/1998			1996–1997			1987–1993		
	Mean excess return	Std. Dev.	Alpha	Mean excess return	Std. Dev.	Alpha	Mean excess return	Std. Dev.	Alpha	Mean excess return	Std. Dev.	Alpha
D1	1.55%	6.07%	0.71%	1.92%	3.15%	0.17%	1.98%	3.92%	−0.84%	1.64%	4.50%	0.91%**
D2	1.55%	4.58%	0.63%*	2.01%	3.13%	0.12%	1.59%	2.98%	0.62%	1.49%	5.03%	1.03%
D3	1.42%	3.97%	0.34%	1.37%	2.73%	0.46%	1.43%	3.12%	1.36%***	1.14%	3.91%	0.57%
D4	1.33%	3.38%	0.86%***	1.04%	3.14%	−0.31%	1.39%	3.10%	0.51%	1.44%	3.23%	0.82%**
D5	0.99%	3.16%	0.06%	1.38%	3.07%	−0.24%	1.38%	3.19%	0.05%	1.32%	5.14%	0.79%
D6	1.36%	2.67%	0.58%***	1.59%	2.88%	−0.13%	1.66%	2.33%	0.75%*	0.39%	6.14%	0.13%
D7	0.88%	2.49%	0.40%**	0.76%	2.89%	−0.78%	0.84%	2.69%	−0.09%	0.89%	3.81%	0.93%*
D8	1.09%	2.43%	0.50%**	0.85%	2.66%	−0.62%	0.83%	2.36%	−0.49%	1.03%	3.98%	0.77%*
D9	0.84%	2.43%	0.33%	0.93%	2.24%	0.21%	1.10%	2.02%	−0.28%	1.43%	3.55%	0.57%
D10	1.01%	3.24%	0.22%	0.90%	2.08%	−0.61%	1.34%	2.06%	−0.49%	1.20%	4.98%	0.37%
1–10 spread	0.54%	6.46%	0.49%	1.03%*	2.29%	0.78%	0.64%	2.95%	−0.35%	0.44%	6.48%	0.54%

Panel B: Market Neutral

	Asian crisis											
	1994–2000			1997–6/1998			1996–1997			1985–1993		
	Monthly Exc. Return	Std. Dev.	Alpha	Monthly Exc. Return	Std. Dev.	Alpha	Monthly Exc. Return	Std. Dev.	Alpha	Monthly Exc. Return	Std. Dev.	Alpha
D1a	1.60%	4.10%	0.59%*	1.60%	3.28%	0.34%	2.16%	3.38%	−0.77%	1.94%	4.37%	0.16%
D1b	0.79%	3.43%	0.24%	1.45%	2.05%	0.45%	1.06%	1.90%	0.93%***	1.56%	3.06%	1.26%***
D1c	1.17%	3.10%	0.59%	1.95%	1.81%	1.05%***	1.82%	1.90%	0.20%	0.56%	3.86%	1.19%
D1	1.15%	3.22%	0.45%	1.61%	1.98%	0.47%	1.64%	1.95%	0.10%	2.30%	7.27%	0.91%
D2	0.65%	2.36%	0.04%	1.15%	1.69%	0.06%	1.23%	1.60%	−0.09%	1.07%	2.22%	1.43%**
D3	0.73%	1.95%	0.20%	0.98%	1.56%	0.02%	1.07%	1.23%	0.25%	0.83%	2.05%	1.04%**

D4	0.59%	1.45%	0.19%	0.65%	1.16%	−0.37%**	0.94%	0.80%	0.20%	0.70%	1.98%	0.15%
D5	0.52%	1.04%	0.25%**	0.67%	0.92%	0.01%	0.77%	0.71%	0.47%*	0.86%	2.29%	0.27%*
D6	0.54%	0.99%	0.31%***	0.61%	0.99%	−0.09%	0.82%	0.81%	0.18%	1.21%	2.87%	0.65%***
D7	0.37%	0.94%	0.18%	0.48%	0.88%	−0.06%	0.65%	0.81%	0.21%	0.42%	3.03%	0.23%
D8	0.34%	1.04%	0.13%	0.19%	0.64%	−0.15%	0.38%	0.52%	−0.06%	0.59%	2.06%	0.07%
D9	0.56%	1.25%	0.22%	0.26%	0.86%	−0.48%	0.52%	0.70%	−0.15%	0.59%	1.68%	0.31%
D10	0.60%	1.97%	0.24%	0.22%	1.25%	−0.67%***	0.43%	0.98%	−0.28%	0.66%	3.45%	−0.04%
D10a	0.55%	1.78%	0.15%	0.26%	0.70%	0.02%	0.31%	1.15%	−0.48%	1.12%	5.30%	−0.98%
D10b	0.90%	2.70%	0.42%	0.34%	1.70%	−0.54%	0.72%	1.87%	−0.67%	0.04%	2.29%	0.00%
D10c	0.42%	3.10%	0.16%	0.31%	3.15%	−1.26%**	0.44%	2.30%	0.38%	1.11%	5.08%	0.63%
1–10 spread	0.55%*	2.91%	0.21%	1.39%***	1.56%	1.14%***	1.21%***	1.79%	0.38%	1.63%**	7.75%	0.95%
1a–10c spread	1.18%**	4.33%	0.43%	1.29%*	3.13%	1.60%*	1.72%**	3.82%	−1.16%	0.83%	6.49%	−0.47%

Panel C: Market Neutral spread comparison

		Monthly Exc. Return	Std. Dev.	Alpha	Mkt	W × US	SMB	HML	I HML	PR1YR	US Bd	W GV Bd	Emer Bd	Default	Comm.	R^2_{adj}
1994–2000	1–10 spread	0.55%*	2.91%	0.21%	0.17*	0.09	0.16***	0.03	−0.30	0.03	−0.15	−0.24	0.01	0.54**	0.05	0.43
	1a–10c spread	1.18%**	4.33%	0.43%	0.30*	0.17	0.17**	0.10	−0.27	0.11	−0.37	−0.54**	−0.09	0.72**	0.16**	0.35
1997–6/1998	1–10 spread	1.39%***	1.56%	1.14%***	−0.05	0.08	0.43***	0.02	−0.38	−0.28***	−0.07	−0.74***	−0.19	1.45***	−0.23***	0.62
	1a–10c spread	1.29%*	3.13%	1.60%*	−0.04	0.07	0.46	−0.13	−1.41	−0.71***	1.41	−1.21***	−0.05	1.38*	−0.67***	0.47
1996–1997	1–10 spread	1.21%***	1.79%	0.38%	0.33**	0.03	0.39***	0.26	0.16	−0.04	−0.42	−0.63**	−0.08	0.67*	−0.04	0.68
	1a–10c spread	1.72%**	3.82%	−1.16%	0.93***	0.06	0.52*	0.84**	0.66	0.03	−1.34*	−0.99*	−0.14	0.94	0.21*	0.40
1985–1993	1–10 spread	1.63%**	7.75%	0.95%	−0.10	−0.15	1.03**	0.85**	−0.31	0.41	−0.85**	1.44*	−0.39	−2.36**	−0.12	0.34
	1a–10c spread	0.83%	6.49%	−0.47%	0.60	−0.04	1.09	1.31***	−0.36	0.50	−0.85	2.48**	−0.12	−3.39**	−0.70**	0.26

significantly negative indicating that the best performing funds (of 1996) significantly under-performed the worst performing funds (of 1996), in 1997. These results confirm our previous conclusion that funds in the first decile have no persistence in returns, and that there have more volatile returns than funds in lowest decile. In the 1/1997–6/1998 analysis, all deciles' alphas are negative, 5 of them being significant, but decile 1a is the only (sub)decile with positive (but not significant) alpha. This indicates that some funds were not affected by the crisis, probably because their investment strategies were relatively immune to it.

7.3. Dissolution frequencies

Fig. 2 shows a histogram of hedge funds dissolution frequencies in 1 year as a function of the previous year mean return decile. At the beginning of each year, all hedge funds are put into decile rankings by their mean returns in the previous year. If a hedge fund ceases reporting returns at any time before the end of the year, then this is counted as dissolved.

Top 7 deciles have a more or less constant average rate of dissolution of 7%, it is 12.5% for the bottom 3 deciles. This suggests that bad performance may be a major factor for dissolution, but that good performance is not a protection against it. This result is consistent the finding of no persistence in the best performing funds, but that persistence exists in the middle deciles.

7.4. One-year persistence for hedge fund strategies

This subsection focuses on the persistence in returns for some hedge funds strategies. We consider two strategies with more than 300 funds: Global Macro and Market Neutral, which significantly out-performed the market for the 1/1994–6/2000 period. In this subsection, we determine whether persistence in returns exists for these strategies. We test it for the 1994–2000 period and for the Asian crisis period (1996–1997 and 1997–6/1998). Results for the pre-1994 period are also indicated for comparison. We classify funds in 10 decile portfolios, with the top and bottom decile divided into three for the Market Neutral strategy. Table 8 reports a summary of our results for these strategies.

Panel A reports the results of the analysis for Macro funds. They show that there is no significant difference between good and bad performing funds. Half of the alphas obtained are significantly positive for the whole period, but not for the extreme deciles. These results are stronger than those obtained for the whole database. This confirms the previous findings for these funds. The 1996–1997 Asian crisis subperiods show that some funds

Note to Table 8:
This table reports the result of the estimation of our combined model. Panel A contains the results for the Global Macro funds for different time period. Panel B contains the results for the Market Neutral funds, and Panel C contains a comparison of Market Neutral spread. Each year, all funds are ranked based on their previous year's mean return. Portfolios are equally weighted and weights are readjusted whenever a fund disappears. Monthly Exc. Return is the monthly excess return of the portfolio, Std. Dev. is the standard deviation of the monthly excess return. Mkt is the excess return on the market proxy. SMB, HML, IHML, PR1YR, W × US, US Bd, W Gvt BD, Emerg Mkt BD, Default, and Comm. are factors added to adjust for size, book-to-market, 1-year return momentum, and for the fact that some funds invest in other than US equity market, in bonds not picked up by the risk-free rate or in commodities. All numbers in the Table are monthly percentages.

(decile D3) have persistence in their return despite the Asian crisis. This could either mean that these funds returns were not affected by the crisis, or that they benefit from it. The second hypothesis is more plausible given that we are analyzing Macro funds that per definition anticipate market movements.

Panel B shows the results for the Market Neutral funds. Their are very close to those obtained for the whole hedge funds database in Table 7 but the results are stronger because we found significant alphas in some cases (recall that the Market Neutral strategy represents 712 funds, that is, 25% of our whole hedge funds database). The only significantly positive alphas are those from the middle deciles. Those of the top decile are only significant for the 1985–1993 subperiod. The 1–10 and 1a–10c excess returns spreads are both significant in most of the period considered, but not the alphas, except from the 1997 to 6/1998 period. This indicates that significantly positive difference existed between best and worst performing funds during the Asian crisis period.

As an illustration, Panel C reports Market Neutral's spread decomposition for each of the subperiod considered. There are some interesting differences between these numbers and those obtained for our whole hedge funds database (see Table 7). For the 1994–2000 period, four factors have a significant effect on spreads for the Market Neutral funds, though they were insignificant in the all funds analysis: HML, Default and Commodity (positive), and World Government Bond (negative). In the previous period, their effect was also significant but with the opposite sign, with HML being replaced by IHML. This indicates that the results obtained for our whole hedge funds database may not be valid for one specific strategy of funds, but also that there has been a sharp reversal in strategies for this category of funds after 1994.

8. Conclusion

Using one of the greatest hedge fund database ever used (2796 individual funds including 801 dissolved), we investigated hedge funds performance using various asset-pricing models including an extension form of Carhart's (1997) model, combined with Fama and French (1998), Agarwal and Naik (2002) models and an additional factor that takes into account the fact that hedge funds may invest in emerging market bonds.

Although our sample displays funds returns going back to 1984, the analysis of the survivorship and instant history biases for the 1984–1993 period indicates that serious concerns can be raised about the statistical reliability of the observations reported in this time window. This corresponds to the lack of data about funds that were dissolved prior to 1994 in the databases. Therefore, our conclusions can only be derived for the 1994–2000 period, with a possible reinforcement with results for the 1984–1993 period whenever similar.

We demonstrate that our combined model is able to explain a significant proportion of the variation in hedge fund returns over time. Compared to models used in other hedge fund performance studies, our combined model does a better job describing hedge funds behavior. It appears particularly good for the Equity non-hedge, US Opportunistics, Sector, Global Macro, Long Only Leveraged, and Event Driven funds.

The performance analysis shows that one fourth of individual hedge funds delivers significant positive excess returns, that most of them seem to prefer smaller stocks, and

that many hedge funds invest in emerging market bonds. Analyzing each strategy individually lead to the additional conclusions that 10 out of 13 strategies offer significantly positive excess return. A subperiod analysis showed that over-performance ability is, in most cases, constant over time. However, according to our results, most funds suffered from the Asian crisis.

The analysis of persistence in performance for our whole hedge funds database indicates three main findings that complete our results of the performance analysis. Firstly, best performing funds follow momentum strategies whereas worst performing ones tend to be momentum contrarian. Secondly, best performing funds do not significantly invest in emerging market bonds, whereas lower decile funds do. Thirdly, average return funds prefer high book-to-market stocks, whereas best and worst performing funds may prefer low book-to-market ones. Our main conclusion from this evidence is that there is no persistence in performance for best and worst performing funds, but limited evidence of persistence exists for middle decile funds. This suggests that, even if some hedge funds managers take a lot of risk, which lead them to have very high or low returns for short period of time, many hedge fund managers follow less risky strategies that allow them to out-perform the market for longer period of time. The much stronger results obtained for data before 1994 raise additional suspicion about the presence of severe bias in this part of the database. The Asian crisis analysis suggests that top performing funds in the year before the crisis (1996) had significantly lower returns in the first year of the crisis. Moreover, they significantly under-performed the worst performing funds (of 1996) during the crisis period. The analysis of dissolution frequencies indicates, on the one hand, that bad performance may be a major factor for dissolution, and, on the other hand, that very good performance is not a protection against dissolution.

Finally, the study of two popular strategies that significantly out-perform the market confirms that there is a persistence in positive excess returns for middle decile funds. A further analysis of the results for the Market Neutral strategy indicates that the differences in spread are not explained by the same factors as for the whole hedge fund database. This stresses that funds in different strategy are not influenced by the same factors, and that specific models could be developed for each investment style in the future.

All these results help in understanding the performance of hedge funds and the persistence in this performance over different time period, including a study of the Asian crisis. The next step in the development of model that describes hedge funds behavior, including Trading Strategy (option writing/buying) factors, in order to account for the fact that some hedge funds exhibit nonlinear option-like exposures to standard asset-classes, as found by Fung and Hsieh (1997, 2001).

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