Hedge Fund Returns, Risk and Fees and Systematic Equity Factors

By
Rosemary Walker
and
Robert A. Weigand*

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Washburn University
School of Business
1700 SW College Ave.
Topeka, KS 66621
785-670-1308
www.washburn.edu/sobu

* Rosemary Walker is associate professor of economics, School of Business, Washburn University, Topeka, KS. Robert Weigand is professor of finance and Brenneman Professor of Business Strategy, Washburn University, School of Business, Topeka, KS. Comments should be directed to Rosemary Walker, School of Business, Washburn University, 1700 SW College Ave. Topeka, Kansas 66621, 785-670-2054, rosemary.walker@washburn.edu.

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Rosemary Walker
Associate Professor of Economics
Washburn University School of Business
1700 SW College Ave., Topeka, Kansas 66621
785.670.2054 / rosemary.walker@washburn.edu

Robert A. Weigand*
Professor of Finance and
Brenneman Professor of Business Strategy
Washburn University School of Business
1700 SW College Ave., Topeka, Kansas 66621
785.670.1591 / rob.weigand@washburn.edu

Abstract

We investigate the extent to which hedge funds earn alpha — the component of returns that can be attributed to manager skill — in excess of a set of systematic equity factors. We find that a 4-factor performance attribution model explains between 15%-45% of hedge fund returns, depending on hedge fund style. We also document a strong positive relation between alpha-generation and systematic risk, implying that funds must take on more systematic risk exposure to earn larger alphas. There is no clear-cut relation between hedge fund fees and alpha, however, as the average alpha earned by high-fee funds is approximately equal to the average alpha earned by low-fee funds. Moreover, no hedge fund style consistently earns sufficient alpha to cover average management fees. The dispersion of hedge fund alpha supports the idea that manager skill exists, but in small supply, implying that access to skilled managers is critical. After accounting for other database biases identified by previous researchers, hedge funds' net alpha generation is significantly negative. We find little evidence that, as an overall industry, hedge funds create value for investors.

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* Corresponding author.

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We investigate the extent to which hedge funds earn alpha, and evaluate the evolution of ideas and methods used to separate alpha from the beta, or systematic, component of returns. Numerous authors have made the case that one of the major factors contributing to the recent financial crisis was too much complexity — particularly in security design and risk modeling (*e.g.*, Schwarcz [2009]). We assert that, like many aspects of the 21st century investing environment, estimation of hedge fund alpha may have become so complicated that the process now adds little value for trustees and board members of smaller endowment and pension funds, who need a framework that allows them to understand the extent to which their hedge fund allocation may have generated excess returns, and how much they should pay for those returns. We propose a simpler, more direct method for estimating alpha, and use that method to investigate the magnitude of hedge fund alpha from 1980-2008.

The alternative asset/hedge fund space suffers from a gradually increasing perception of over-promising and under-delivering, similar to the reputation of long-only mutual funds (as documented by Elton, *et al.* [1993], Carhart [1997], Bogle [1998], and, more recently, Barras, Scalliet and Wermers [2010]). Hedge fund returns are "... lower than commonly supposed" according to Malkiel and Saha [2005, p. 80], who also find that hedge funds are significantly riskier than more conventional investments. Fung, Xu and Yau [2004] also report negative average alphas for hedge funds, and Pojarliev and Levich [2008] find negative mean risk-adjusted alphas among a sample of currency managers. Wallerstein, Tuchschmid and Zaker [2010] conclude that many hedge fund replication products deliver performance that is competitive with hedge funds at significantly lower fee levels.

These results are at odds with the way hedge funds have positioned themselves as absolute return vehicles that can largely immunize their performance from the effect of systematic risk factors and deliver pure alpha (vs. relative return vehicles, like long-only mutual funds, which earn most of their returns from exposure to systematic factors). Numerous academic studies focus on how effective hedge funds are at separating alpha from beta. The majority of these studies find that a significant proportion of hedge fund returns can be explained by market-related factors, including Fung and Hsieh [1997, 2001, 2002, 2004a, 2004b], Agarwal and Naik [2004], Hasanhodzic and Lo [2006], and Wallerstein, Tuchschmid and Zaker [2010]. Of course, these results contradict hedge funds' claims regarding their ability to hedge beta and mainly earn alpha, and beg the question of whether effective alpha-beta separation is feasible. For example, Mladina and Coyle [2010] find that even the acclaimed Yale Endowment owes much of its historical performance to "heavy exposure to common equity risk factors" [p. 43]. Jarrow [2010] goes a step further and questions whether alpha even exists, concluding that "... the existence and persistence of positive alphas is more a fantasy than a fact" [p. 18].

Research also indicates that hedge fund beta is more complex than equity beta because some of the strategies hedge funds employ induce additional risks beyond those inherent in the assets in which they invest. Hedge funds often use derivatives, short-selling and leverage to generate alpha during periods of extreme returns in financial markets, which can lead to exposure to higher-moment equity risks such as skewness and kurtosis (Fung and Hsieh [2001], Weisman [2002], Bondarenko [2004], and Diez and Garcia [2006]). Other studies have found that hedge funds' complex strategies cause their returns to be nonlinearly related to systematic factors (Fung and Hsieh [1997, 2001, 2004b], Mitchell and Pulvino [2001],

Amin and Kat [2003], Agarwal and Naik [2004], Hasanhodzic and Lo [2007], and Fung, Hsieh, Naik, Ramadorai [2008], and Agarwal, Bakshi and Huij [2009]).

The complexity of hedge funds' investment strategies is matched by researchers' attempts at modeling hedge funds' exposure to systematic factors. For example, Fung and Hsieh [2001, 2004b] emphasize the option-like traits of hedge fund performance and recommend the inclusion of lookback straddle returns as systematic factors in their model. Mitchell and Pulvino [2001] show that the returns from risk arbitrage resemble the payoff from selling uncovered index put options. Both studies find that hedge funds' risk-return characteristics are indeed nonlinear, and stress the importance of taking these option-like features into account when analyzing hedge fund returns.

We propose that complex theoretical and empirical frameworks such as these suffer from several weaknesses. First, because hedge funds' exposure to higher-moment risks often results from positions taken during extreme market conditions, effectively modeling exposure to these risks requires knowledge regarding hedge funds' strategies and the timing of these strategies — information that few hedge funds report. Second, because this information would be hedge fund-specific, nonlinear higher-moment risk exposure cannot effectively be reduced to a general model that could be applied objectively to most hedge funds in a certain style category. Third, one of the key purposes of an alpha-beta performance attribution analysis is to report results to pension fund and endowment officers in order to demonstrate that performance fees are based on true alpha generation. It is unlikely that the average trustee or board member is going to understand the complex statistical techniques required to model nonlinear exposure to higher-moment sources of risk. Fourth, for many smaller pension funds and endowments, the exotic indexes used in the modeling process are not investable

alternatives, because their allocation to hedge funds often represents the riskiest position in their portfolios. From the perspective of these investors, the beta exposure of their hedge fund allocation is more relevant when it can be compared to the beta exposure of their equity allocation.

In this study we take a step toward technological simplicity by modeling hedge fund returns' relation with systematic equity factors only — a topic that has received little coverage in the academic literature, but is used more often in industry. The benefits of such an approach include: the results are more likely to be understood by pension trustees and board members; the technique can be applied objectively to hedge funds in all the major style categories; and it allows us to address a list of research questions likely to be of interest to decision-makers at smaller pension and endowment funds, whose boards typically contain many members who do not analyze or monitor their funds' investments full time.

It should also be noted that modeling hedge fund returns as a linear function of a limited set of factors is not without problems. As mentioned previously, hedge funds often use derivative securities, which induces nonlinearities in their risk/return profiles, so linear models may only approximate the true relation. Another problem involves the effect of missing variables, which can induce bias in the estimation of key model parameters. The typical approach in the academic literature, however, is to assume that employing more technology to solve these problems always improves the analytical process. We argue that the recent history of financial modeling offers a compelling counterexample to this view, and that overly complicated analyses often induce more costs than benefits. For example, consider the conclusions of Martinelli and Ziemann [2010] in their recent study of portfolio construction:

> In trying to … make their risk evaluation more sophisticated, many asset managers increase the number of risk parameters to be estimated, which in turn

> leads to less robust and less relevant results than if they had stuck with a simple measure [p. 3].

The simpler, more direct method for estimating alpha and beta we propose (presented in the next section) allows for direct comparability with the risk and return of a fund's equity allocation, requires a relatively small number of parameters to be estimated (which leaves less room for error), and will undoubtedly be more intuitive to trustees and board members at many smaller pension and endowment funds.

Previewing our major results, we find that a Fama-French [1993]-Carhart [1997] 4-factor performance attribution model explains between 15%-45% of hedge fund returns, depending on hedge fund style, and that hedge fund alphas estimated from a 4-factor model are considerably smaller than those from a 1-factor model. The dispersion of hedge fund alpha supports the idea that manager skill exists, albeit in small supply, which implies that access to skilled managers should be an important criterion when making a hedge fund allocation decision. We find that 4-factor alphas increase with exposure to the Mkt – Rf factor, indicating that managers must take on more systematic risk to earn higher alphas. Managers' ability to earn alpha increases with assets under management (AUM), but alpha begins to diminish past a certain threshold of AUM, consistent with the framework of Berk and Green [2004], although this effect has mitigated over time to the point that it now only affects a small subset of hedge funds. Our most damning finding is that hedge funds do not earn enough alpha to cover management fees, and that fees are only weakly related to alpha-generation — the average alpha of high-fee managers is approximately equal to the average alpha of low-fee managers. After taking fees and database biases into account, hedge fund alphas are negative for all style categories, suggesting that, as an overall industry, hedge funds do not create value for investors.

DATA AND METHODOLOGY

Our primary source of data is the Hedge Fund Research (HFR) Database [2009], which contains monthly returns, assets under management, fee and other information on a universe of hedge funds from 1980-2008. Use of the HFR Database allows us to investigate alphas and betas by hedge fund style. Much of the existing literature focuses on consolidated Fund-of-Funds data, so examining fund risk and return across different styles provides a unique perspective.

As noted by Fung and Hsieh [2006], hedge fund databases suffer from a variety of biases, including selection bias (induced by both data vendors and the manner in which hedge funds self-report their performance), survivorship bias (funds that close and get deleted from databases tend to have lower returns), backfill bias (managers wait to see if a new fund is successful before deciding to report results to data vendors), and liquidation bias (hedge fund managers usually stop reporting to a database before final liquidation of a fund). Fung and Hsieh [2006] find that survivorship and incubation bias have the most significant effect on reported returns, resulting in an average upward bias of 2.5 and 1.5 percent, respectively. We take these upward biases into account when interpreting our empirical results in the following section.

The Fama-French [1993] and Carhart [1997] monthly systematic return factors, the excess market return and a time series of the risk-free rate are obtained from Ken French's data library (French [2009]). The factors are constructed to capture the effects of market forces thought to systematically affect equity returns:

1) Mkt – Rf, the excess return earned by a broadly diversified portfolio of US equities over the risk-free rate;

2) SMB, or "Small Minus Big," the excess return earned by small stocks over large stocks, often referred to as the size premium;

3) HML, or "High Minus Low," the excess return earned by portfolios of stocks with high book-to-market ratios, often referred to as the value premium; and

4) UMD, or "Up Minus Down," a factor constructed to capture the excess return earned by stocks with positive price momentum.

For all the months (t) for which data are available, we estimate both a 1-factor market model regression for each fund (i):

$$R_{i,t} - r_{ft} = \alpha_{i,t}^{1F} + \beta_{i,1}^{1F}\left(R_{MKT_t} - r_{ft}\right) + \varepsilon_{it} \quad (1)$$

and a Fama-French 4-factor market model regression (FF4):[1]

$$R_{i,t} - r_{ft} = \alpha_{i,t}^{FF4} + \beta_{i,1}^{FF4}\left(R_{MKT_t} - r_{ft}\right) + \beta_{i,2}^{FF4}\left(R_{SMB_t}\right) + \beta_{i,3}^{FF4}\left(R_{HML_t}\right) + \beta_{i,4}^{FF4}\left(R_{UMD_t}\right) + \varepsilon_{it}. \quad (2)$$

The alpha for firm i is computed as the monthly return of hedge fund i minus the fund's expected return based on a 1-factor regression:

$$\hat{\alpha}_{i,t}^{1F} = \overline{R}_{i,t} - \left[\overline{r}_{ft} + \hat{\beta}_{i,1}^{1F}\left(\overline{R_{MKT} - r_f}\right)\right] \quad (3)$$

and a FF4 regression:

$$\hat{\alpha}_{i,t}^{FF4} = \overline{R}_{i,t} - \left[\overline{r}_{ft} + \hat{\beta}_{i,1}^{FF4}\left(\overline{R_{MKT} - r_f}\right) + \hat{\beta}_{i,2}^{FF4}\left(\overline{R}_{SMB}\right) + \hat{\beta}_{i,3}^{FF4}\left(\overline{R}_{HML}\right) + \hat{\beta}_{i,4}^{FF4}\left(\overline{R}_{UMD}\right)\right]. \quad (4)$$

The results reported in the exhibits that follow are calculated as the average alpha, beta, t-statistic and R-squared from these regressions. Note that first estimating the parameters on the fund level and then averaging across all funds avoids a "diversification effect" that would bias our results towards finding higher beta coefficients and lower alphas.

EMPIRICAL RESULTS

Descriptive Statistics

Exhibit 1 shows the net asset value (NAV), age, annual management fee and average incentive fee of the hedge funds in our sample. Half of all hedge funds managed $175 million or less in the 1980s, which declined to $148 million or less in the 2000s, with mean NAV increasing significantly over the same period. The increase in mean NAV and the slight decrease in median NAV reflects the startup of many new, smaller funds and an increase in the size of the largest, longer-lived funds. Mean and median fund age increases slightly over the decades, indicating that many hedge funds liquidate after 3-4 years. Only a small number of hedge funds continue operating over anything resembling the long run.

The exhibit also shows that the mean management fee is 1.4% per year, and the mean incentive fee is 15.0% of profits per year. The mean and median management and incentive fees self-reported by hedge funds to the HFR database remain constant over time, and are lower than the anecdotal "two-and-twenty" frequently cited by the financial press. This contradicts the popular notion that as the number of hedge funds increased (there were over 10,000 in 2007), the fees they charge would be competed downward. The magnitude of the fees presented in Exhibit 1 will be used later in the paper to investigate the extent to which investors receive added value from their hedge fund allocations.

Hedge Fund Betas by Style

Exhibit 2 shows the average betas of the hedge funds in our sample, reported by fund style. In this and most of the exhibits that follow, results are reported from both a 1-factor and 4-factor model. This exhibit addresses two questions: the degree to which the returns of the

various hedge fund styles are related to systematic equity risk factors, and which factors affect each style.[2]

Long/Short Equity Hedge funds generally maintain a positive market beta exposure (mean Mkt – Rf beta = +0.53), a large-cap emphasis (mean SMB beta = −0.76), a growth-stock tilt (mean HML beta = −0.36), and long exposure to the price momentum factor (mean UMD beta = +0.11). Over one-third (36%) of the returns of the average Equity Hedge fund can be explained by systematic equity factors.

The positive mean market beta exposure of Event-Driven funds (Mkt – Rf = +0.40) is consistent with these funds' strategies, as a rising stock market implies greater deal flow. Event-Driven funds have small but significant exposure to the small-cap factor (SMB beta = +0.10), as takeover targets tend to have smaller market capitalizations than the average stock. The positive HML factor (+0.12) suggests that these funds hold more positions in value stocks (takeover targets are more likely to be undervalued), and the UMD factor (+0.08) indicates the stocks in which these funds invest also tend to have positive price momentum.

Funds-of-Funds have positive market beta exposure (Mkt – Rf = +0.37), a slight tilt towards the large-cap factor (SMB = −0.02), no significant exposure to the value factor, and positive exposure to the price momentum factor (UMD = +0.14). The Macro style has the lowest market beta exposure (Mkt – Rf = +0.17), large-cap exposure to the size factor (SMB = −0.08), a value tilt (HML = +0.09), and positive price momentum exposure (UMD = +0.19). The Relative Value style has the second-lowest market beta coefficient (Mkt – Rf = +0.27) and no significant exposure to the size, value, or momentum factors.

The results reported in Exhibit 2 confirm that the returns of all hedge fund styles are related to the basic equity risk factor Mkt – Rf, although the estimated coefficients on this

factor (ranging from 0.107 to 0.525) are significantly lower than that of the average diversified equity portfolio (1.00). The 4-factor model explains 15%-45% of hedge fund returns, depending on style, and the explanatory power of the 4-factor model is several times larger than that of the 1-factor model for all styles. Not surprisingly, the most diversified style of hedge fund, the Fund-of-Funds (FOF), has the highest adjusted R-squared. Almost half (45%) of the returns of this hedge fund style can be explained by exposure to systematic equity factors. Macro style hedge funds have the lowest 4-factor R-squared (14.8%), followed by Relative Value at 23.8%. Based on the results presented in Exhibit 2, we conclude that the 4-factor performance attribution model provides a better fit for the returns of most hedge fund styles, and that hedge fund returns are significantly related to most of the equity factors, with the exception of the Relative Value style, whose returns are, on average, only related to the basic excess return factor Mkt – Rf.

Hedge Fund Alphas by Style

Exhibit 3 shows average annual hedge fund alphas, reported by style and sorted into quartiles (Q1-Q4 progresses from highest to lowest), with average *t*-statistics reported beneath each value. In this exhibit we investigate the extent to which hedge funds earn alpha over and above the common equity risk factors, and which hedge fund styles generate the largest alphas.

Our results indicate that alphas measured with the 1-factor (low R-squared) model are positive and significant for all strategies for the first 3 quartiles (except FOFs), and negative and significant for the 4th quartile. Funds-of-Funds have the lowest alphas — this style's overall mean alpha is negative when measured with the 4-factor model. We find that the 4-factor alphas are smaller than the 1-factor alphas in most cases (third panel), indicating that

accounting for hedge funds' exposure to all common equity risk factors results in lower reported alpha, and by implication, lower incentive fees. With the lowest exposure to the equity factors (R-squared = 14.9%) and highest 4-factor alpha (0.48%), the Macro Strategy has the best performance record over time.

The results reported in Exhibit 3 are not adjusted for management fees, however (which averaged 1.4%), or the database biases reported by Fung and Hsieh [2006] (which averaged 4.0%). Adjusting the Exhibit 3 results for average management fees puts all hedge fund categories underwater — no hedge fund style generates sufficient alpha over and above the effects of the FF4 common equity factors to cover average fees. Subtracting another 4.0% for the effects of survivorship and incubation bias allows us to conclude that, as an overall industry, hedge funds do not add value proportional to the fees they charge investors.

Of course, it is not the case that *all* hedge funds fail to generate alpha consistently greater than average management fees. The last row in the first two panels shows the percentage of each hedge fund style with alpha greater than the average fee of 1.4%. The results are enlightening. Between 0.7% (Funds of Funds) and 10.6% (Global Macro) of hedge fund styles have consistently generated 4-factor alphas greater than average management fees. This finding is consistent with the idea that manager skill exists in the hedge fund space, albeit in considerably small supply. Over 90% of hedge funds fail to earn alpha greater than their annual management fee, indicating that access to the elite subset of skilled managers should be a critical consideration — and probably the most important consideration — when making a hedge fund allocation decision. Investors who do not have a strong conviction that they are getting access to the most skilled managers would do better by avoiding allocating to hedge funds altogether. Moreover, if the Fung and Hsieh [2006] database biases apply equally

to the reported returns of this subset of high-performing hedge funds, then our conclusion must be further amended, as we find *no* hedge funds in *any* style category that consistently generate alphas greater than management fees after adjusting returns downward by an additional 4.0%.

Hedge Fund Alphas by Management Fee

Exhibit 4 shows average hedge fund alphas reported by quintile of management fee. If management skill exists and markets are reasonably efficient at disseminating news regarding the distribution of skill, we would expect to see alphas increasing with fees. Alphas measured via the 1-factor model are largest in the highest and *lowest* fee categories, however. The 4-factor alphas are also generally larger in the highest and lowest fee ranges, a result that is difficult to reconcile with the idea that more skilled managers command higher fees.[3] We again find that the 4-factor alphas are significantly smaller than the 1-factor alphas, and that Funds-of-Funds consistently deliver the lowest alphas. The high-fee Relative Value style hedge funds are the only category of fund that has delivered alphas in excess of average management fees.[4]

Hedge Fund Alphas by Market Beta and Time Period

Exhibit 5 shows average alphas for each hedge fund style sorted by Mkt – Rf beta. This exhibit provides insight into the question of whether managers have to take on greater exposure to systematic risk to generate higher alphas. The 1-factor alphas show a slight tendency to increase with the Mkt – Rf beta throughout the quartiles, but the 4-factor alphas increase monotonically for each hedge fund style (except Q3 to Q4 for Equity Hedge). These findings provide strong evidence that the average hedge fund must take on increased exposure to common equity risk factors to earn larger alphas, which runs contrary to the view that

hedge funds are effective at immunizing their performance from systematic risk effects. As above, Funds of Hedge Funds consistently deliver the lowest alphas.

Exhibit 6 shows alphas sorted by the 1980s, 1990s, and 2000-2008 period. Four-factor alphas for all hedge fund styles decrease from the 1990s to the 2000s — the decade in which the hedge fund concept attracted the most AUM. Fund-of-Funds' average 4-factor alpha in the 2000s is negative even before management fees, and this style's 1-factor alpha is not significantly different than zero. No hedge fund style generated average alpha larger than average management fees in any decade.

Multivariate Analysis of the Determinants of Alpha

Exhibit 7 shows the result of a multivariate regression analysis that models the determinants of hedge fund 4-factor alphas:

$$\alpha_{FF4} = \gamma_0 + \gamma_1 AUM + \gamma_2 AUM^2 + \gamma_3 \sum_{i=1}^{4} d_i Type + \gamma_4 \sum_{j=1}^{3} d_j Decade + \gamma_5 MngtFee \qquad (5)$$

- AUM and AUM^2 = the level of assets under management and assets under management squared;
- *Type* = 0,1 indicator variables for type of hedge fund, with FOFs omitted;
- *Decade* = indicator variables for the 1980s, 1990s, and 2000s; and
- *MngtFee* = the percentage annual management fee.

All hedge fund style types have positive and significant regression coefficients, consistent with the results reported in Exhibit 3, which shows that all styles earn small positive alphas on average (except FOFs) before accounting for management fees and database biases. The negative coefficient on the *Decade* indicator variable indicates that alphas have been declining over time (although, as shown in Exhibit 1, fees have remained

constant). The small positive coefficient on the *MngtFee* variable suggests that, on average, funds that charge higher fees earn slightly larger alphas.

The variables AUM and AUM^2 are both significant, indicating that hedge fund alphas initially increase as a fund attracts more AUM (positive coefficient), but alpha-generation decreases past a certain threshold of AUM (negative coefficient on AUM^2). This finding is consistent with the diminishing returns to scale argument made by Berk and Green [2004], whereby most funds find it difficult to scale up their unique strategies across a larger capital investment. Re-estimating Equation (5) by decade and omitting the *Decade* indicator variable allows us to calculate the point of inflection at which more AUM suppresses alpha. The point of inflection averaged $1.03 billion in the 1980s, $5.5 billion in the 1990s, and $44.0 billion from 2000-2008. This allows us to estimate that 19.8% of funds earned lower alpha due to increases in AUM in the 1980s, but this problem only affected 1.5% of funds in the 1990s, and only 0.1% of funds in the 2000s. These findings suggest that, in practical terms, investors should not be highly concerned about placing funds with a hedge fund that has large AUM, as the diminishing returns to scale effect has mitigated over time.

CONCLUSIONS

We investigate the extent to which hedge funds earn alpha — the component of returns that can be attributed to manager skill — in excess of a set of systematic equity factors. Hedge funds have incentive to maximize alpha because it determines the size of the performance fees they can charge. We find that a Fama-French [1993]-Carhart [1997] 4-factor performance attribution model explains between 15%-45% of hedge fund returns, depending on hedge fund style, and that hedge fund alphas estimated from a 4-factor model are considerably smaller than those from a 1-factor model. All hedge fund styles have significant

exposure to the full range of systematic equity factors except for the Relative Value style, which is only related to the Mkt – Rf factor.

The dispersion of hedge fund alpha supports the idea that manager skill exists, albeit in small supply, and from the perspective of investors, access to skilled managers should be an important criterion when making a hedge fund allocation decision. Average alphas increase with exposure to the Mkt – Rf factor, indicating that managers must take on more systematic equity risk to earn higher alphas, a finding that contradicts hedge funds' claim regarding their ability to hedge beta risk and earn pure alpha. Managers' ability to earn alpha increases with assets under management (AUM), but alpha begins to diminish past a certain threshold of AUM, consistent with the framework of Berk and Green [2004], although we find that this effect has mitigated over time — the threshold at which AUM exerts a negative influence on alpha averaged over $40 billion in the 2000s, representing only 0.1% of all hedge funds.

We further find that aggregate alphas are not sufficiently large to cover management fees, and that fees are only weakly related to alpha-generation. The average alpha of high-fee managers is approximately equal to the average alpha of low-fee managers. We also find that average hedge fund alpha has declined moderately over time. Four-factor alphas for all hedge fund styles decrease from the 1990s to the 2000s — the decade in which the hedge fund concept attracted the most AUM. After taking fees and database biases into account, hedge fund alphas are negative for all style categories, suggesting that, as an overall industry, hedge funds do not create value for investors.

Endnotes

1. For terminological simplicity we will begin referring to the 4-factor regressions as Fama-French (FF4) regressions, even though the UMD factor was proposed by Carhart [1997].
2. Significant exposure to a systematic equity factor does not imply that a hedge fund style is invested in a specific type of stock, just that the strategy employed by the fund creates an exposure to the same market forces that affect portfolios of stocks with certain characteristics (size, value, momentum, etc.).
3. These results are also consistent with the hypothesis that management skill exists, but a sufficient number of investors do not have information regarding the distribution of skill.
4. Relative Value funds' average alpha is larger when measured using the 4-factor model because, on average, this style of hedge fund had no exposure to the HML, SMB or UMD factors.

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EXHIBIT 1

Hedge Funds' Net Asset Value and Age and Management and Incentive Fees.

Net Asset Value (millions)

	Mean	Median	Std. Dev.	Min	Max
Overall	2,820	149	29,066	0	741,917
1980-1989	571	175	1,193	1	6,758
1990-1999	1,022	151	2,669	0	46,569
2000-2008	3,064	148	30,926	0	741,917

Fund Age (years)

	Mean	Median	Std. Dev.	Min	Max
Overall	4.2	3.2	3.9	0.0	27.8
1980-1989	2.3	1.8	1.8	0.0	8.9
1990-1999	3.3	2.5	3.3	0.0	18.9
2000-2008	4.4	3.3	4.0	0.0	27.8

Annual Management Fee (percent)

	Mean	Median	Std. Dev.	Min	Max
Overall	1.4	1.5	0.6	0.0	20.0
1980-1989	1.6	1.5	1.0	0.0	6.0
1990-1999	1.4	1.5	0.7	0.0	6.0
2000-2008	1.4	1.5	0.6	0.0	20.0

Annual Incentive Fee (percent)

	Mean	Median	Std. Dev.	Min	Max
Overall	15.0	20.0	7.6	0.0	50.0
1980-1989	15.3	20.0	8.8	0.0	33.3
1990-1999	14.8	20.0	8.2	0.0	50.0
2000-2008	15.0	20.0	7.5	0.0	50.0

EXHIBIT 2

Mean Hedge Fund Betas by Hedge Fund Style. The exhibit reports mean hedge fund betas by style, with mean *t*-statistics below each beta coefficient.

Hedge Fund Betas by Style

	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
1-Factor Model					
Mkt-Rf	0.485	0.372	0.320	0.107	0.261
	46.52***	24.56***	64.83***	12.60***	16.21***
mean Adj. R^2	4.89%	4.58%	5.21%	5.47%	5.10%
4-Factor Model					
Mkt-Rf	0.525	0.396	0.368	0.170	0.274
	44.47***	23.42***	69.53***	10.56***	14.80***
SMB	-0.760	0.101	-0.019	-0.081	0.006
	-4.83***	6.66***	-3.53***	-4.05***	0.40
HML	-0.360	0.124	0.011	0.091	-0.028
	-2.43***	4.65***	1.62	3.07***	-0.59
UMD	0.111	0.078	0.144	0.193	0.011
	6.31***	4.57***	39.07***	10.76***	0.60
mean Adj. R^2	35.93%	33.28%	45.12%	14.82%	23.80%

***, **, * indicates significance at the .01, .05, and .10 levels, respectively.

EXHIBIT 3

Average Annual Hedge Fund Alphas (in percent) by Hedge Fund Style. The exhibit reports mean hedge fund alphas by style, with mean *t*-statistics below each alpha. In the first two panels, "% > mngt. fee" indicates the percentage of funds that generate alpha greater than the average management fee of 1.4%.

1-Factor Model

	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
Overall	0.43	0.51	0.05	0.61	0.29
	18.17***	11.75***	4.07***	12.60***	7.84***
1st Quartile	1.54	1.63	0.54	1.92	1.41
	26.08***	16.51***	20.10***	17.65***	15.62***
2nd Quartile	0.57	0.53	0.17	0.73	0.44
	130.88***	63.74***	89.23***	82.92***	55.94***
3rd Quartile	0.21	0.27	-0.01	0.35	0.06
	48.23***	41.98***	-3.33***	46.91***	7.93***
4th Quartile	-0.60	-0.37	-0.53	-0.54	-0.75
	(-14.52)***	(-5.76)***	(-26.65)***	-4.99***	(-14.36)***
% > avg. fee	8.6%	10.2%	0.4%	12.9%	7.3%

4-Factor Model

	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
Overall	0.29	0.27	-0.09	0.48	0.22
	4.09***	2.46**	-6.64***	6.27***	3.10***
1st Quartile	0.87	0.67	0.14	1.14	1.03
	3.33***	8.21***	3.75***	4.58***	4.33***
2nd Quartile	0.30	0.47	0.02	0.51	0.40
	12.98***	6.29***	1.92*	10.24***	12.47***
3rd Quartile	0.24	-0.15	-0.08	0.36	0.04
	9.51***	-0.39	-7.96***	11.24***	-1.24
4th Quartile	-0.23	0.08	-0.45	-0.08	-0.58
	-2.14**	-0.50	-12.01***	-0.51	-4.42***
% > avg. fee	6.7%	9.0%	0.7%	10.6%	7.1%

1-Factor Alphas Minus 4-Factor Alphas

	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
Overall	0.14	0.25	0.14	0.13	0.07
	38.77***	21.87***	63.72***	25.09***	13.33***
1st Quartile	0.67	0.96	0.41	0.78	0.39
	0.12	5.97***	9.19***	1.07	1.48
2nd Quartile	0.27	0.06	0.16	0.22	0.04
	3.23***	10.42***	29.78***	6.52***	2.27**
3rd Quartile	-0.03	0.42	0.07	-0.01	0.02
	10.11***	5.96***	21.08***	7.91***	5.52***
4th Quartile	-0.37	-0.45	-0.08	-0.46	-0.17
	2.24**	1.49	4.92***	0.21	0.42

***, **, * indicates significance at the .01, .05, and .10 levels, respectively.

EXHIBIT 4

Average Annual Hedge Fund Alphas (in percent) Sorted by Management Fee. The exhibit reports mean hedge fund alphas by management fee, with mean *t*-statistics below each alpha.

1-Factor Model

Fee Range	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
0.0 to 0.5%	0.78	0.62	0.01	1.07	0.51
	3.56***	3.57***	0.18	5.98***	3.56***
0.5 to 1.0%	0.37	0.45	0.12	0.51	0.19
	11.62***	8.64***	5.94***	6.16***	2.07**
1.0 to 1.5%	0.39	0.39	0.07	0.18	0.17
	17.16***	6.74***	1.74*	1.33	3.48***
1.5 to 2.0%	0.47	0.62	-0.09	0.69	0.42
	7.74***	7.57***	-1.38	9.87***	7.35***
2.0 to 20%	1.13	1.03	0.49	0.86	0.43
	2.26**	1.80*	18.90***	4.61***	0.77

4-Factor Model

Fee Range	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
0.0 to 0.5%	0.73	0.54	-0.20	0.65	0.52
	3.18***	3.04**	-3.04***	3.05***	3.67***
0.5 to 1.0%	0.18	0.33	0.01	0.37	0.18
	5.32***	6.04***	0.40	4.17***	1.29
1.0 to 1.5%	0.23	0.26	-0.14	0.03	0.05
	5.19***	4.43***	-8.71***	0.19	0.94
1.5 to 2.0%	0.43	0.24	-0.13	0.63	0.23
	1.88*	1.04	-2.75***	4.64***	2.48**
2.0 to 20%	0.69	0.63	-0.09	0.60	3.52
	1.23	2.45**	-0.86	3.38***	1.06

1-Factor Alphas Minus 4-Factor Alphas

Fee Range	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
0.0 to 0.5%	0.05	0.08	0.21	0.42	-0.01
	0.72	2.93***	4.91***	3.03***	-0.35
0.5 to 1.0%	0.20	0.12	0.11	0.14	0.01
	13.16***	8.16***	8.51***	5.29***	0.11
1.0 to 1.5%	0.16	0.14	0.21	0.15	0.12
	4.19***	6.22***	11.97***	1.86*	3.45***
1.5 to 2.0%	0.04	0.38	0.04	0.06	0.19
	0.21	1.84*	7.35***	0.56	2.33**
2.0 to 20%	0.44	0.41	0.58	0.26	-3.10
	3.67***	1.28	0.09	3.92***	-0.88

***, **, * indicates significance at the .01, .05, and .10 levels, respectively.

EXHIBIT 5

Average Annual Hedge Fund Alphas (in percent) Sorted by Mkt – Rf Beta. The exhibit reports mean hedge fund alphas by Mkt – Rf Beta, with mean *t*-statistics below each alpha.

1-Factor Model

Fee Range	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
1st Quartile	0.52	0.46	-0.06	0.44	-0.18
	10.73***	4.16***	-2.06**	3.12***	-2.29**
2nd Quartile	0.41	0.46	-0.01	0.71	0.13
	13.45***	8.41***	-0.70	10.14***	2.84***
3rd Quartile	0.45	0.52	0.09	0.58	0.50
	15.68***	6.17***	5.99***	14.26***	11.37***
4th Quartile	0.38	0.64	0.17	0.77	0.68
	7.26***	7.21***	6.30***	9.21***	7.22***

4-Factor Model

Fee Range	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
1st Quartile	0.17	0.16	-0.24	0.11	-0.31
	2.24***	0.99	-7.49***	0.78	-4.00***
2nd Quartile	0.20	0.30	-0.17	0.44	0.03
	6.38***	5.48***	-8.81***	5.76***	0.54
3rd Quartile	0.32	0.42	-0.04	0.46	0.45
	9.68***	4.64***	-2.53**	10.22***	10.08***
4th Quartile	0.30	0.59	0.07	0.85	0.72
	4.17***	6.60***	1.79*	6.77***	2.74***

***, **, * indicates significance at the .01, .05, and .10 levels, respectively.

EXHIBIT 6

Average Annual Hedge Fund Alphas (in percent) by Time Period. The exhibit reports mean hedge fund alphas by decade, with mean *t*-statistics below each alpha.

1-Factor Model

Period	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
1980-1989	0.53	0.49	0.39	0.57	0.26
	6.45***	6.00***	6.86**	8.66***	1.77
1990-1999	0.65	0.47	0.32	0.76	0.39
	22.56***	13.87***	24.90***	20.16***	11.44***
2000-2008	0.39	0.53	-0.01	0.57	0.27
	13.97***	9.10***	-0.48	9.42***	6.32***

4-Factor Model

Period	Equity Hedge	Event - Driven	Fund of Funds	Macro	Relative Value
1980-1989	0.39	0.36	0.26	0.88	0.23
	5.35***	3.84***	3.95***	7.23***	1.48
1990-1999	0.49	0.36	0.26	0.64	0.30
	16.67***	11.21***	13.74***	15.91***	8.39***
2000-2008	0.25	0.24	-0.15	0.43	0.27
	2.97***	1.62	-8.89***	4.53***	2.48**

***, **, * indicates significance at the .01, .05, and .10 levels, respectively.

EXHIBIT 7

Multivariate Regression Analysis of Factors Affecting 4-Factor Alphas. The exhibit shows regression coefficients, standard errors, *t*-statistics and the adjusted R-squared from estimation of the following model:

$$\alpha_{FF4} = \gamma_0 + \gamma_1 AUM + \gamma_2 AUM^2 + \gamma_3 \sum_{i=1}^{4} d_i Type + \gamma_4 \sum_{j=1}^{3} d_j Decade + \gamma_5 MngtFee$$

Variable Definitions:

- *AUM* and AUM^2 = the level of assets under management and assets under management squared;
- *Type* = 0,1 indicator variables for type of hedge fund, with FOFs omitted;
- *Decade* = indicator variables for the 1980s, 1990s, and 2000s; and
- *MngtFee* = the percentage annual management fee.

Multivariate Regression Model

Variable	Coefficient	Standard Error	*t*-statistic	Significance	Adj. R^2	*F*-Stat
Constant	0.800	0.510	15.546***	0.000	0.004	177.792
AUM (bil)	0.510	0.007	7.651***	0.000		
AUM^2	0.000	0.000	-6.237***	0.000		
Equity Hedge	0.305	0.015	20.388***	0.000		
Macro	0.469	0.021	22.033***	0.000		
Relative Value	0.185	0.021	8.948***	0.000		
Event Driven	0.294	0.023	12.706***	0.000		
80s, 90s, 00s	-0.311	0.017	-18.563***	0.000		
Mngt. Fee (%)	0.104	0.011	9.454***	0.000		

***, **, * indicates significance at the .01, .05, and .10 levels, respectively.