HEDGE FUND PERFORMANCE AND MANAGER SKILL

FRANKLIN R. EDWARDS*
MUSTAFA ONUR CAGLAYAN

Using data on the monthly returns of hedge funds during the period January 1990 to August 1998, we estimate six-factor Jensen alphas for individual hedge funds, employing eight different investment styles. We find that about 25% of the hedge funds earn positive excess returns and that the frequency and magnitude of funds' excess-returns differ markedly with investment style. Using six-factor alphas as a measure of performance, we also analyze performance persistence over 1-year and 2-year horizons and find evidence of significant persistence among both winners and losers. These findings, together with our finding that hedge funds that pay managers higher incentive fees also have higher excess returns, are consistent with the view that fund manager skill may be a partial explanation for the positive excess returns earned by hedge funds. © 2001 John Wiley & Sons, Inc. Jrl Fut Mark 21:1003–1028, 2001

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*Correspondence author, Columbia Business School, 625 Uris Hall, New York, New York 10027; e-mail: fre1@columbia.edu

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■ *Franklin R. Edwards is the Arthur F. Burns Professor of Economics and Finance in the Graduate School of Business at Columbia Business School in New York City, New York.*

■ *Mustafa Onur Caglayan is a Global Markets Officer of the Foreign Exchange Research Department at JPMorganChase Securities Inc. in New York City, New York.*

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INTRODUCTION

The explosive growth of hedge funds during the 1990s resulted in a number of studies of hedge fund performance (Ackermann, McEnally, & Ravenscraft, 1999; Agarwal & Naik, 2000a, 2000b; Brown, Goetzmann, & Ibbotson, 1999; Edwards & Caglayan, in press; Edwards & Liew, 1999; Fung & Hsieh, 1997, 2000; Liang, 1999; Schneeweis & Spurgin, 1998). This study contributes to the literature in two ways. First, to examine the question of whether hedge funds earn excess returns, we use information on the monthly net returns of individual hedge funds during the period January 1990 through August 1998 and estimate a six-factor risk model to obtain individual fund alphas (or excess returns). Second, to address the question of whether fund managers have skill, we examine persistence in the excess returns of individual hedge funds. The greater the persistence in returns is, the more likely it is that hedge fund performance is due to manager skill rather than chance (although we recognize that luck can never be entirely ruled out as the explanation). Both parametric and nonparametric statistical procedures are used to test for persistence in fund performance with individual fund alphas over 1-year and 2-year horizons as measures of performance.

In general, we find substantial evidence of both excess returns and performance persistence. A significant proportion of hedge funds earned excess returns over the sample period, although the magnitude and frequency of these returns varied significantly with the investment style used by the hedge funds. We also find evidence of performance persistence over 1-year and 2-year horizons, and the significance of this persistence varies with investment style (data limitations prevented testing for persistence over longer time horizons). This evidence is consistent with the hypothesis that at least some hedge fund managers may possess skill. This interpretation also is reinforced by our finding that hedge fund performance is positively related to the incentive fee paid by hedge funds: The higher the incentive fee (the percentage of a fund's profits paid to fund managers) is, the better a fund's after-fee performance is. A possible explanation for the superior performance of hedge funds is that they may have been able to attract skilled fund managers by paying them more.

These findings stand in sharp contrast to those for mutual funds. Most studies of mutual fund performance do not find evidence of positive excess returns (see Brown & Goetzmann, 1995; Carhart, 1997; Elton, Gruber, & Blake, 1996; Elton, Gruber, Das, & Hlavka, 1993; Goetzmann & Ibbotson, 1994; Gruber, 1996; Hendricks, Patel, & Zeckhauser, 1993; Jensen, 1968; Malkiel, 1995; Sharpe, 1966; Treynor,

1965). In addition, higher management fees are generally associated with poorer, not better, mutual fund performance (Carhart, 1997; Malkiel, 1995). Appendix B provides a summary of past studies of both mutual funds and hedge funds.

This study also differs from past studies of hedge fund performance. Ackermann et al. (1999), Brown et al. (1999), and Agarwal and Naik (2000a) used a single-factor model to estimate hedge fund excess returns (alphas), whereas we use a multifactor model. Although Liang (1999) and Agarwal and Naik (2000b) employed a multifactor model to estimate hedge fund alphas, they did not use individual fund returns, as we do. Instead, they used average hedge fund returns (an equally weighted or value-weighted average of either all hedge funds or all hedge funds with a particular investment style) to estimate alphas. Although this procedure may be informative for investors who are considering investing in an index of hedge funds, it does not address the questions examined in this study. Furthermore, it is widely recognized that even within a particular investment style hedge fund strategies can be quite heterogeneous.[1] Thus, using the average returns of hedge funds to estimate a multifactor model may be inappropriate because it implicitly forces all hedge funds (within a particular investment style) to have identical factor loadings on the risk factors (or asset-class factors). In contrast, our use of individual fund returns to estimate multifactor alphas allows individual hedge funds to have different factor loadings on the risk factors.[2]

The closest studies to ours are those by Fung and Hsich (1997) and Agarwal and Naik (2000c). These studies also used individual hedge fund returns to estimate a multifactor model to obtain estimates of funds' excess returns, but they used different multifactor models. In addition, they did not use hedge fund alphas to test for persistence in hedge fund performance, as we do.

The organization of this article is as follows. The next section describes the data used in the study, and the third section discusses several potential data biases. The fourth section presents the multifactor model used to estimate individual fund alphas and discusses our findings

[1]Correlations between the monthly returns of hedge funds within a particular investment style are typically quite low, suggesting substantial heterogeneity within a style classification. The medians of the pairwise correlation coefficients are 0.33 for funds of funds, 0.28 for event-driven, 0.17 for global-macro, 0.30 for global, 0.49 for long-only, 0.09 for market-neutral, 0.34 for sector-specific, and 0.53 for short-selling. The averages of the pairwise correlation coefficients for these styles are almost identical.

[2]This procedure may also account for the effect of greater leverage on hedge fund returns. Everything else being equal, a fund with greater leverage should have higher factor loadings on the related risk factors than a fund pursuing an identical investment strategy but with less leverage.

with respect to the existence of excess returns. The fifth section examines the relationship between individual funds' excess returns and the incentive fees paid by funds as well as the size and age of funds. The sixth section analyzes the persistence in hedge funds' excess returns, and the last section summarizes our findings and conclusions.

DATA

This study uses Managed Account Reports (MAR/Hedge) data, which, as of August 1998, contained information on 1,665 hedge funds with about $150 billion under management. Hedge funds differ significantly in their investment styles. MAR distinguishes eight (self-declared) styles. The definitions of these styles are contained in Appendix A. On the basis of our sample period, January 1990 through August 1998, 94% of the capital under management by hedge funds was invested in the following five styles: global (nearly 29%), global-macro (28%), market-neutral (16%), funds of funds (14%), and event-driven (7%). Furthermore, almost 90% of the new hedge funds formed since 1990 were concentrated in these five investment styles.

There is a large size disparity among hedge funds. On the basis of our data, in December 1997 the largest 64 hedge funds (or the largest 4%) managed 53% of the total capital under management by all hedge funds in the sample. This size disparity also can be seen in the large difference between the mean ($59 million) and median ($15 million) size of the hedge funds in the sample. Another characteristic of hedge funds is their widespread use of an asymmetrical incentive-fee structure. Hedge funds typically impose two fees on investors: an annual management fee, which usually ranges from 1 to 3% of assets under management, and an incentive fee, which is typically a percentage of the fund's annual net profits above a designated hurdle rate. The median (mean) incentive fee for all hedge funds is about 17% (18.58%) and ranges from 1 to 50%. This fee structure differs significantly from that used by most mutual funds, where management fees are typically a flat percentage of assets under management.[3] An issue, therefore, is whether the use of incentive fees attracts superior fund managers to hedge funds, resulting in better performance by hedge funds.

[3]The Investment Advisors Act of 1940 does not permit mutual funds to use an asymmetrical incentive-fee contract. However, it does permit the use of symmetrical fee contracts: managerial compensation must be computed symmetrically around some chosen benchmark return, where fees decrease when managers underperform in the same way that they increase when managers outperform. Few mutual funds have adopted such a fulcrum-fee structure.

POTENTIAL DATA BIASES

Estimating the excess returns of hedge funds is subject to several potential data biases associated with reported hedge fund returns. Fung and Hsieh (2000), following previous literature, discussed four biases: survivorship bias, instant history bias, selection bias, and multiperiod sampling bias. A survivorship bias may exist if the reported return data exclude the returns of nonsurviving hedge funds because nonsurviving funds probably have poorer performance.[4] Our study, however, includes the return histories for 496 nonsurviving hedge funds, and we estimate the alphas (excess returns) for those funds and all surviving funds. We estimate that if the returns of the nonsurviving hedge funds had not been included in the analysis, there would have been a survivorship bias of 1.85% in average annual hedge fund returns (the difference between the annualized mean return for only surviving funds in the sample and the annualized mean return for all surviving and nonsurviving funds in the sample). This bias ranges from a low of 0.36% for market-neutral funds to a high of 3.06% for long-only funds. These findings are comparable to those of Liang (2000) and Fung and Hsieh (2000), who used the Tremont Advisers Statistical Services (TASS) (Europe) database for their analyses.[5]

An instant history bias may exist because when data vendors add a new hedge fund to their database, they may backfill earlier returns for that fund. Because it is reasonable to believe that only hedge funds with good performance records choose to report their performance to data vendors, the practice of backfilling the returns history of funds may result in upward biased returns for newly reporting hedge funds during their early (reported) histories. Fung and Hsieh (2000) estimated an instant history bias of as much as 1.4% for average annual hedge fund returns. We also find that the average annual return for hedge funds during their 1st year of existence is about 1.17 percentage points higher than their average returns in subsequent years. Thus, following Fung and Hsieh, we exclude the first 12 months of returns for all hedge funds in our sample when estimating individual fund alphas to avoid an instant history bias.[6]

[4]Poor performance is probably the main reason for nonsurvival. In our sample, from January 1990 to August 1998, the average annualized return was 9.50% for nonsurviving funds and 14.92% for surviving funds.

[5]Liang (2000) reported an annual survivorship bias of 2.24%, and Fung and Hsieh (2000) reported a 3.00% annual survivorship bias.

[6]In our sample, 207 funds have return histories of less than 12 months. As a result, this restriction alone reduces our sample size from 1,665 funds to 1,458 funds.

A selection bias may exist if only hedge funds with good performance (or skilled managers) choose to report their performance. In this case, the reported data may overstate true hedge fund performance. However, there is anecdotal evidence that very successful hedge funds also may choose not to disclose their performance because they are already closed to new investors and have no interest in attracting additional clients. If this is prevalent, the reported data will understate the true performance of hedge funds. Thus, the selection bias caused by the voluntary reporting of hedge fund performance may result in either an overstatement or understatement of hedge fund performance. This potential bias exists for all studies of hedge fund performance, but without data on funds that do not disclose their performance to data vendors, there is no way to estimate how serious it is. Fung and Hsieh (2000) argued that it is probably very small, if it exists at all.

A final potential bias, which Fung and Hsieh (2000) called a *multi-period sampling bias*, may exist if some hedge funds have very short return histories. In particular, they argued that if investors typically require 36 months of history before investing in a hedge fund, estimates of excess returns based on shorter return histories may be misleading to those investors. Fung and Hsieh (2000), however, investigated the use of different return histories and concluded that this bias appears to be very small, if it exists at all. In this study, we require that all hedge funds in the sample have a minimum of 24 months of returns, after excluding the first 12 months of returns for all hedge funds to correct for any potential instant history bias.[7] We chose a 24-month-minimum requirement, rather than a 36-month-minimum, because a 36-month-minimum results in the exclusion of many nonsurviving funds, potentially introducing an upward bias in returns due to survivorship bias.[8] In fact, we estimate that when a 24-month-minimum history is imposed (after the first 12 months of returns are excluded), the average annual hedge fund return is 0.32% higher than when no minimum history requirement is imposed on the sample of funds. It is notable that this difference in return is nearly the same (0.29%) when only a 12-month-minimum history is imposed, which suggests that it would not make much of a

[7]Fung and Hsieh (2000) required a minimum of 36 months of return history, and Ackermann et al. (1999) required a minimum of 24 months.

[8]Because the median life of hedge funds is about 3 years, a 36-month-minimum history requirement may result in many nonsurviving funds being excluded from the sample, possibly introducing a survivorship bias. Even the requirement of a 24-month minimum reduces our sample from 1,458 funds to 836 funds. Furthermore, it is also obvious from the data that many investors invest in hedge funds with much shorter histories than 36 months, so a 36-month-minimum requirement may result in misleading returns for such investors.

difference whether we adopted a 12-month-minimum or a 24-month-minimum history requirement.[9]

ESTIMATING EXCESS RETURNS

To estimate excess returns for individual hedge funds, we use a multifactor model similar to that of Fama and French (1993, 1995, 1996). Specifically, we measure excess returns as the estimated alpha for individual hedge funds, using the following multifactor model:

$$R_i - R_f = \alpha + b \times (\text{S\&P } 500 - R_f) + h \times (\text{HML}) + s \times (\text{SMB}) + w \times (\text{WML}) + g \times (\text{TERM}) + k \times (\text{DEF}) + e_i \quad (1)$$

R_i is the monthly return of hedge fund i, R_f is the 30-day Treasury bill (T-bill) rate, HML is the monthly return on a portfolio of high book-to-market stocks minus the monthly return on a portfolio of low book-to-market stocks (see Fama & French, 1995, 1996; Rosenberg, Reid, & Lanstein, 1985),[10] SMB is the monthly return on a portfolio of small stocks minus the monthly return on a portfolio of large stocks (see Banz, 1981; Fama & French, 1995, 1996),[11] WML is the monthly return on a stock portfolio of the past year's winners minus the monthly return on a stock portfolio of the past year's losers (see Asness, 1995; Carhart, 1997; Jegadeesh & Titman, 1993; Moskowitz & Grinblatt, 1999),[12] TERM is the monthly return on a long-term government bond portfolio minus the 1-month-lagged 30-day T-bill return (see Fama & French, 1993),[13] DEF is the monthly return on a portfolio of long-term

[9]Fung and Hsieh (2000) found a bias of 0.60% when they required a 36-month-minimum, which they called insignificant. The higher return they found after imposing a 36-month-minimum history requirement might have been due to a greater survivorship bias in their sample because of the 36-month minimum.

[10]Book-to-market values are defined as book value per share divided by the market price per share. The index is created with equity information obtained from Datastream. Only the stocks that report book-to-market values, market capitalization, and monthly returns for the prior year are used in the formation of the index. The HML portfolio is value-weighted, rebalanced quarterly, and size- and momentum-neutral (see Liew & Vassalou, 2000).

[11]The SMB index is value-weighted, rebalanced quarterly, and value- and momentum-neutral. Market capitalization is calculated by the number of shares outstanding being multiplied by the market price of the stock (see Liew & Vassalou, 2000).

[12]Winners are defined as stocks that have had high monthly returns during the past year, excluding the most recent month; losers are those that have had low monthly returns during the past year, excluding the most recent month. Excluding last-month returns reduces problems related to bid–ask bounce. The WML index is value-weighted, rebalanced quarterly, and value- and size-neutral (see Liew & Vassalou, 2000).

[13]TERM is meant to capture the market risk in bond returns due to unexpected changes in interest rates. If the T-bill rate is a proxy for the long-run expected return on bonds, TERM reflects the deviation of long-term bond returns from expected returns.

corporate bonds minus the monthly return on a portfolio of long-term government bonds (see Fama & French, 1993),[14] and e_i is the usual error term (or residual return).

The use of a multifactor model to estimate hedge funds' excess returns seems imperative. Hedge funds use a variety of investment strategies and may hold both long and short positions, so that we would expect the returns of individual hedge funds to depend on different economic risk factors. Furthermore, individual hedge funds (even within a particular investment style) may have quite different sensitivities to the same risk factors, depending on their particular trading strategies and their use of leverage (see footnote 1). Another issue in studies of this kind is the choice of factors to include in a multifactor model. There is no obvious answer to this question, and different researchers have employed different factors (see Agarwal & Naik, 2000c; Fung & Hsieh, 1997). We chose to employ Fama–French-style risk factors because these have been identified in the literature as representing macroeconomic risk factors capable of explaining asset returns (see Liew & Vassalou, 2000). Although these factors are associated primarily with U.S. capital markets, anecdotal evidence suggests that most hedge funds trade primarily in U.S. markets. Although we do not report them in this article, we also experimented with additional international asset factors and less orthodox domestic explanatory factors, but we found that the addition of these factors had virtually no effect on our estimates of fund alphas.[15]

Table I provides, for all hedge funds and for each investment style separately, averages of individual fund alphas estimated with Equation 1. In addition, it provides, for comparison, two other measures of individual funds' excess returns: average absolute excess returns (average returns minus the T-bill rate) and average Sharpe ratios. In general, annualized excess returns measured by six-factor alphas are lower than absolute excess returns for funds pursuing directional trading strategies (e.g., global-macro, global, and long-only funds).[16] An exception is short-selling (also a directional strategy), for which the average annualized six-factor alpha (12.72%) is higher than the average annualized absolute excess return (0.50%). Because short-selling funds pursue a strategy of

[14]DEF reflects the default premium in corporate bond returns and captures changes in economic conditions that affect perceptions of default risk

[15]In particular, we included in Equation 1 the following variables: returns on the Morgan Stanley Composite Index (MSCI) Europe–Asia–Far East stock index, a liquidity premium variable measured as the spread between on-the-run and off-the-run government bonds, and returns on three major currencies, the deutsche mark, British pound, and Japanese yen.

[16]See Agarwal and Naik (2000a) for definitions of directional trading strategies.

TABLE I

Measures of Excess Returns by Investment Style: January 1990 to August 1998

	Average Annual Return	*Average Absolute Excess Return*	*Average Sharpe Ratio*	*Average Six-Factor Alpha*
All hedge funds	12.22% (0.004)	7.36% (0.004)	0.83 (0.035)	8.52% (0.004)
Funds of funds	9.93% (0.005)	5.07% (0.005)	0.87 (0.071)	6.72% (0.006)
Event-driven funds	15.48% (0.009)	10.62% (0.009)	1.09 (0.077)	12.12% (0.013)
Global-macro funds	13.34% (0.013)	8.48% (0.013)	0.53 (0.083)	5.64% (0.015)
Global funds	12.03% (0.007)	7.17% (0.007)	0.55 (0.040)	6.72% (0.007)
Long-only funds	14.98% (0.028)	10.12% (0.028)	0.63 (0.135)	9.24% (0.020)
Market-neutral funds	11.81% (0.006)	6.95% (0.006)	1.44 (0.131)	11.76% (0.008)
Sector funds	21.27% (0.024)	16.41% (0.024)	1.04 (0.168)	15.24% (0.025)
Short-sell funds	5.36% (0.028)	0.50%[a] (0.028)	0.12[a] (0.100)	12.72% (0.026)

Note. This table provides three measures of hedge funds' excess returns: absolute excess returns, Sharpe ratios, and six-factor Jensen alphas. The *average absolute excess return* is the average of individual hedge funds' excess returns: a fund's average return in excess of the risk-free rate ($R_i - R_f$). The *average Sharpe ratio* is the average of individual funds' Sharpe ratios. A fund's *Sharpe ratio* is the fund's absolute excess return divided by the standard deviation of the fund's monthly returns. To calculate fund Sharpe ratios, we exclude hedge funds with fewer than 24 months of returns. The *average six-factor alpha* is the average of the individual fund alphas obtained by the estimation of the six-factor model (Equation 1) for the aforementioned period. Hedge funds with fewer than 24 months of returns are excluded from these regressions as well. These measures of excess returns are reported for all hedge funds and by investment style. All returns are annualized returns. Standard errors are in parentheses.

[a]Not significant at the 10% level. The rest of the reported measures of excess returns in the table are significant at the 1% level.

primarily shorting overvalued U.S. stocks, this result is hardly surprising, given the general upward movement in U.S. stocks over the sample period. Finally, for market-neutral funds (which primarily pursue nondirectional strategies), the average annualized alpha is much higher (11.76%) than the average annualized absolute excess return (6.95%).

Sharpe ratios can also differ significantly from returns measured as six-factor alphas. In particular, short-selling funds display a very low average Sharpe ratio (0.12) but have one of the highest average alphas (12.72%). However, with the exception of short-selling funds, the rankings of styles by Sharpe ratios are largely consistent with the rankings by six-factor alphas. For example, the three highest ranked styles by Sharpe ratios (market-neutral, event-driven, and sector funds) are also the three highest ranked by six-factor alphas, and the lowest ranked style (global-macro funds) has both the lowest Sharpe ratio and the lowest six-factor alpha.

Thus, the significant differences among alternative measures of excess returns for different investment styles of hedge funds provide a justification for using a multifactor model to estimate excess returns. This procedure may better control for the risk factors to which hedge

funds are exposed and as a result may provide a more realistic estimate of hedge funds' excess returns.

Table II provides statistics on the individual fund alphas obtained by the estimation of Equation 1 for each hedge fund in the sample. First, only 25% of all hedge funds (207) have significantly positive alphas (at the 5% level), and on average these funds earn an annualized excess return of about 19%. Second, the average annualized excess returns of successful funds differ significantly by investment style: 28.6% for sector-specific funds, 26.5% for global funds, 23.2% for short-selling funds, 21.6% for event-driven funds, 20.3% for global-macro funds, 17.3% for market-neutral funds, 17.2% for long-only funds, and 13.0% for funds of funds. Third, the likelihood of a fund earning a significantly positive excess return differs by investment style. On average, only about one in four hedge funds is likely to earn a positive significant excess return (based on the percentage of funds with significantly positive alphas), whereas the comparative figures are one in two and one in three for market-neutral funds and funds of funds, respectively. (Because there are only 21 sector-specific funds and 15 short-selling funds, we do not give much weight to the results for these funds.) In sum, although the likelihood is relatively low of selecting a hedge fund that will earn an excess return, the payoff is very high for those investors who are able to select successful funds. This clearly makes the question of whether it is possible to identify funds that will perform well in the future an extremely important issue. In a later section of this article, we explore whether investors may be able to use a fund's past returns to predict its future performance.

EXCESS RETURNS AND INCENTIVE FEES

This section examines whether hedge funds that employ attractive incentive fees to compensate fund managers perform better than funds that pay less attractive incentive fees. Assuming that at least some money managers possess skill, it stands to reason that by paying managers higher fees, a hedge fund may be able to attract superior money managers. In addition, higher incentive fees coupled with the common practice of requiring fund managers to have their own money invested in the fund may better align the interests of managers and investors, also improving fund performance. (Requiring managers to have their own funds at risk should mitigate the risk-seeking behavior that could result from the optionlike feature of paying managers high incentive fees.)

To test this hypothesis, we attempt to control for the possibility that hedge fund performance may also be associated with the size and

TABLE II

Descriptive Statistics on the Excess Returns of Individual Hedge Funds: January 1990 to August 1998

$$R_i - R_f = \alpha_i + b_i(S\&P\ 500 - R_f) + h_i(HML) + s_i(SMB) + w_i(WML) + g_i(TERM) + k_i(DEF) + e_i$$

	All Hedge Funds	*Funds of Funds*	*Event-Driven Funds*	*Global-Macro Funds*	*Global Funds*	*Long-Only Funds*	*Market-Neutral Funds*	*Sector-Specific Funds*	*Short-Sell Funds*
Number of funds	836	200	78	68	306	9	139	21	15
Number of funds with positive significant alphas	207	67	21	11	27	2	71	7	5
Percentage of funds with positive significant alphas	25	34	27	16	9	22	51	33	33
Annualized average of positive significant alphas (%)	18.72	12.96	21.60	20.28	26.52	17.16	17.28	28.56	23.16
Annualized average of all other funcs' alphas (%)	5.16	3.60	8.64	2.88	4.92	6.96	6.00	8.52	7.44
Average size of funds with positive significant alphas (million $)	155.78	76.83	102.25	1,733.90	52.27	2.19	82.56	22.06	12.20
Average size of all other funds (million $)	69.45	45.28	60.57	115.37	72.51	17.56	68.63	37.14	31.75
Average number of months in existence for funds with positive significant alphas	60	60	74	91	60	46	55	45	52
Average number of months in existence for all other funds	53	48	51	51	55	53	50	47	75
Median incentive fees of funds with positive significant alphas (%)	20.00	15.00	20.00	15.00	15.00	15.00	20.00	20.00	20.00
Median incentive fees of all other funds (%)	2.00	1.81	12.00	2.00	1.50	12.50	6.00	8.50	9.25

Note. This table provides a description of the individual hedge fund alphas obtained by the estimation of Equation 1 for individual hedge funds during the aforementioned period. Funds with positive significant alphas (at the 5% level) are compared to funds that do not have significantly positive alphas, with respect to the magnitude of the alphas, the size and age of a fund, and the level of incentive fee paid by the fund. *Size* is the fund's net assets under management. *Age* is the number of months since the fund's inception to either its demise or August 1998, and *incentive fee* is the percentage of net profits paid to fund managers. Alphas are annualized averages.

longevity (age) of a fund. In particular, larger hedge funds may have better performance than smaller funds (measured as assets under management) because they may enjoy economies of scale, such as lower information and trading costs, and may be able to take positions that smaller funds cannot take. However, as hedge funds grow larger, they may also incur diseconomies of scale because large size may preclude them from quickly moving into and out of certain markets or investments. There have been several instances of large hedge funds returning money to their investors to reduce their size to improve performance. Thus, we might expect the relationship between hedge fund performance and fund size to be nonlinear: performance should improve the most as fund size increases over smaller size ranges but should improve at a slower rate (or even decline) as fund size becomes increasingly larger. Finally, we also control for the length of time that a fund has been in existence because longevity itself may be a proxy for the skill of fund managers, regardless of the fund's fee structure. Presumably, investors will not continue for long to retain and pay for investment managers who underperform other managers and funds.

Table II provides some simple statistics on the characteristics of successful hedge funds versus all other hedge funds. With all hedge funds taken together, successful hedge funds appear to pay much higher incentive fees and to be significantly larger. Most of the size disparity, however, is due to the large size disparity among funds in three investment styles: global-macro, event-driven, and funds of funds.

Table III shows the results of a regression analysis of excess returns (six-factor alphas) on five variables: size, the reciprocal of size (to capture nonlinearity in the size–performance relationship), age, and management and incentive fees.[17] The level of the incentive fee is statistically significant and is positively related to excess returns for all hedge funds taken together and all investment styles.[18] The estimates in Table III suggest that, on average, hedge funds that pay high incentive fees (20% or more) earn annualized excess returns about 3–6 percentage points higher than funds that pay low incentive fees. Thus, higher incentive fees appear to be worth the cost to hedge fund investors: Higher fees may attract superior fund managers. Our results may also provide support for

[17]Only 516 of the 836 funds report fees. As a result, there are not enough funds reporting fees to do a regression analysis for three investment styles: sector-specific, long-only, and short-selling.

[18]Zero–one dummy variables are used to separate hedge funds into low-, moderate-, and high-incentive-fee categories, where low fees are less than or equal to 2%, moderate fees are greater than 2% but less than 20%, and high fees are greater than 20%. The omitted category in the regression analysis is the low-fee funds. The distribution of hedge fund incentive fees is not normal.

TABLE III

Size, Age, and Fees as Determinants of Six-Factor Alphas: January 1990 to August 1998

$$\textit{Six-Factor Alpha} = b_0 + b_1(\textit{Moderate Incentive Fee}) + b_2(\textit{High Incentive Fee}) + b_3(\textit{Size}) + b_4(1/\textit{Size}) + b_5(\textit{Age}) + b_6(\textit{Management Fee}) + \varepsilon$$

Variables	*All Hedge Funds*	*Funds of Funds*	*Event-Driven Funds*	*Global-Macro Funds*	*Global Funds*	*Market-Neutral Funds*
Constant	0.5272***	0.6102***	0.7679**	−0.6298	0.0489	0.7107***
Moderate incentive fee	0.2131**	0.1477	0.3202	0.2336	0.2988	0.2630**
High incentive fee	0.3408***	0.2625**	0.4328*	0.3642*	0.3272*	0.5252***
Size	0.0002*	0.0004*	0.0093*	0.0006*	0.0002	0.0028*
Size reciprocal (1/size)	−0.3259**	−0.3064*	−0.8022*	−0.5736	−0.3449	−0.5982*
Age	0.0004	0.0003	0.0051	0.0132***	0.0065**	0.0069***
Management fee	−0.0191	−0.0133	−0.5030	−0.0036	−0.0028	−0.1025
Number of observations	516	125	41	43	186	97
Adjusted R^2	0.238	0.186	0.233	0.319	0.094	0.245

Note. This table reports estimates from a regression of six-factor fund alphas (estimated with Equation 1) on hedge funds' size, age, and fees. *Size* is the amount of a fund's net assets under management. *Age* is the number of months that a fund has been in existence. Two types of managerial fees are distinguished: management fees and incentive fees. The management fee is an annual percentage of the net assets managed by a fund, which presumably covers the costs of administering the fund. The incentive fee is a percentage of the fund's annual net profits paid to managers in reward for good performance. All variables other than incentive fees are continuous variables. The incentive-fee variables are zero–one dummy variables that separate funds into high-, moderate-, and low-incentive-fee categories. High-incentive-fee funds are those with incentive fees of 20% or higher; moderate-incentive-fee funds are those with incentive fees higher than 2% and lower than 20%, and low-incentive-fee funds are those with incentive fees of 2% or less. Low incentive fee is the omitted category in the regressions. Equations are estimated for all hedge funds taken together and for each investment style. Because only 516 of the 836 funds in the sample report incentive fees, there are not enough funds reporting fees in three investment styles to do an analysis: sector-specific, long-only, and short-selling. Statistical significance at 1, 5, and 10% levels are indicated by ***, **, and * respectively.

those who argue that the use of an asymmetrical incentive-fee structure can improve the performance of fund managers.[19]

Both size variables are statistically significant for all hedge funds and for all investment styles, except global-macro and global. A positive coefficient on the size variable together with a negative coefficient on the size reciprocal variable indicates that hedge fund performance increases at a declining rate as fund size increases. In addition, age appears to be a significant explanatory factor only for global, global-macro, and market-neutral funds. Finally, the management fee (a flat percentage of assets) variable has a negative but statistically insignificant relationship with excess returns. This result is consistent with prior work on mutual fund performance, which typically finds a statistically significant negative relationship between management fees and fund returns (see Carhart, 1997; Malkiel, 1995).

These results are subject to an important caveat. It is possible that the causality between fees and returns may run the other way: Funds that have had high returns in the past may, as a result, pay their managers a higher incentive fee. This interpretation, however, is not consistent with the pattern of incentive fees we observe in the data. Typically, the level of the incentive fee (a percentage of profits) is set at the inception of a fund and is rarely changed thereafter. For example, in our data we are able to observe a cross section of funds' fees for two dates, April 1997 and August 1998. In examining these data, we find no changes in reported incentive fees over the period April 1997 to August 1998. Thus, we believe that the causality runs from incentive fees to performance, rather than the reverse, so our interpretation of the foregoing results is correct. The causality problem may be greater for the size and age variables. However, these variables are not the focus of our analysis, which centers on the effect of incentive fees on performance. We include them in the regression analysis only to obtain better estimates for the incentive-fee variable, rather than to obtain estimates of their effects on performance. Thus, the possible existence of two-way causality between the size and

[19]It is often argued that asymmetrical incentive fees provide fund managers with a potential payoff similar to a call option, causing them to adopt a higher risk trading strategy than they otherwise would. Our estimates of individual fund excess returns, however, are already risk-adjusted, in that funds taking greater risks should have higher sensitivities to the risk factors in the estimating equation. In addition, we find no relationship between the level of the incentive fee and the volatility (standard deviation) of a hedge fund's monthly returns, another measure of risk. The lack of a relationship between incentive fees and risk may be explained by the common practice of requiring hedge fund managers to have their own money at risk in the fund, which should moderate the tendency of managers to increase risk.

age variables and fund performance should not affect our estimates of the effect of incentive fees on performance.[20]

MANAGER SKILL AND PERFORMANCE PERSISTENCE

Although a finding that performance is positively associated with the level of incentive fees is suggestive, a more direct test of fund managerial skill may be to look at persistence in hedge funds' returns. In particular, do the top-performing hedge funds continue to be top performers over a long time period? If success were due primarily to luck rather than skill, we would not expect to observe a high degree of persistence in returns among successful hedge funds.[21]

We examine earnings persistence with both nonparametric and parametric tests. The nonparametric test is a two-way winner-and-loser contingency-table analysis, in which winners and losers within a particular investment style are defined as hedge funds with alphas greater (winners) or less (losers) than the median alpha of all funds following the same style. Persistence in this analysis is determined by whether a fund is a winner (or loser) in two consecutive periods of analysis (such as from 1 year to the next). As such, the test emphasizes the frequency with which winners and losers are either repeat winners or repeat losers. Winners in two consecutive periods are labeled *WW*, losers in two consecutive periods are labeled *LL*, and *WL* and *LW* are winners in the first period and losers in the second period and losers in the first period and winners in the second period, respectively. To test for persistence, we use a cross-product ratio (CPR), defined as $(WW \times LL)/(WL \times LW)$ (see Agarwal & Naik, 2000a). The null hypothesis is that there is no persistence, in which case CPR equals one. The statistical significance of the CPR is tested with a Z statistic, which measures the ratio of the natural logarithm of CPR to the standard error of the natural logarithm of CPR.[22] A Z-statistic value of 1.96 corresponds to significance at the 5% level and indicates that the CPR is statistically greater than one.

[20]When size and age are omitted from the equation, the results for the incentive-fee variable are largely unchanged.

[21]It is still possible, of course, that luck could be responsible for some funds having outstanding performance over a long period of time. For example, Soros Fund Management's flagship Soros Quantum fund, a global-macro fund, returned an average of 32% a year after fees between 1969 and 1999. Recently, it suffered huge losses and was forced to reorganize. Does a 31-year run of successful returns indicate management skill or exceptionally good luck (see Norris, 2000)?

[22]The standard error of the natural logarithm of the CPR is calculated as $[(1/WW) + (1/WL) + (1/LW) + (1/LL)]^{(1/2)}$. See Christensen (1990).

Table IV provides the results of the two-way winner-and-loser contingency-table analysis for 1-year selection and 1-year performance periods and for the period 1990 to August 1998.[23] (Results for 2-year selection and 2-year performance periods are almost identical and, therefore, are not reported.) The results in Table IV show the existence of both winner and loser persistence at the 5% significance level or better for all hedge funds and for funds of funds, global-macro funds, and market-neutral funds. For all hedge funds taken together, repeat winners and repeat losers constitute a sum of 57% of the total sample (30% repeat losers and 27% repeat winners). The corresponding figures (the sum of the percentages for repeat winners and repeat losers) are even larger for global-macro (58%) and market-neutral (63%) funds.

The second test of persistence employs regression analysis. With cross-section data, we estimate regressions with 1-year and 2-year selection and performance-period alphas during the 1990–1998 period to determine if past performance is a predictor of future performance. Specifically, for 1-year selection and 1-year performance periods, eight separate cross-section regressions are estimated during the 1990–1998 period, and for 2-year selection and 2-year performance periods, six separate cross-section regressions are estimated. Persistence is considered to exist if the estimated slope coefficients in these equations are significantly greater than zero. Table V reports the averages of the estimated slope coefficients for the respective selection and performance periods for all hedge funds and for separate hedge fund styles. Fama–MacBeth t statistics for the averages of the slope coefficients are reported in parentheses (see Fama & MacBeth, 1973).[24]

The results of this test are similar to those obtained from the two-way winner-and-loser contingency analysis. For 1-year performance and 1-year selection periods, the average slope coefficients are significantly greater than zero at the 10% level for all hedge funds and for the same three investment styles (funds of funds, global-macro funds, and market-neutral funds). The results are the same for 2-year selection and 2-year performance periods but have a higher level of statistical significance.

Taken together, these results support the conclusion that there is persistence in hedge fund performance among both winners and losers. In particular, top-performing fund managers appear to earn higher excess returns on a consistent basis, whereas the poorest performing funds appear to perform badly year after year. On the basis of the 9 years

[23]Once again, each fund in the sample must have a history of at least 24 months, after the first 12 months of its history are excluded.

[24]Equations are estimated for a year only if there are at least 20 hedge funds in the cross section.

TABLE IV

Winner-and-Loser Two-Way Contingency Test: 1-Year Selection Period and 1-Year Performance Period

	All Hedge Funds				*Funds of Funds*				*Event-Driven Funds*			
	WW	*WL*	*LW*	*LL*	*WW*	*WL*	*LW*	*LL*	*WW*	*WL*	*LW*	*LL*
1991	36	26	21	41	6	3	3	7	3	3	2	5
1992	56	38	33	61	10	9	8	11	6	4	2	9
1993	77	52	48	82	17	9	6	31	8	7	6	9
1994	83	95	87	91	15	23	24	14	8	7	7	9
1995	110	142	131	121	25	27	25	27	9	15	15	9
1996	202	140	122	220	36	42	37	41	11	18	12	17
1997	254	147	129	272	57	39	36	60	21	16	15	23
1998	190	191	169	212	48	45	44	49	10	26	24	13
Total	1008	831	740	1100	214	197	183	240	76	96	83	94
Percentage	27	23	20	30	26	23	22	29	22	27	24	27
CPR	1.80***				1.42**				0.90			
Z statistic	8.83				2.54				−0.51			

	Global-Macro Funds				*Global Funds*				*Market-Neutral Funds*			
	WW	*WL*	*LW*	*LL*	*WW*	*WL*	*LW*	*LL*	*WW*	*WL*	*LW*	*LL*
1991	4	4	4	5	11	13	10	15	5	5	6	5
1992	7	4	5	7	20	16	10	26	8	4	4	8
1993	11	3	2	13	25	27	24	28	9	6	5	11
1994	7	11	12	7	34	36	38	33	13	13	9	18
1995	15	11	12	15	38	57	55	40	17	24	17	24
1996	14	15	13	17	67	68	51	75	40	17	17	40
1997	18	12	7	23	87	61	53	96	48	20	17	51
1998	12	13	10	15	60	80	66	75	37	28	25	40
Total	88	73	65	102	342	358	307	388	177	117	100	197
Percentage	27	22	20	31	24	26	22	28	30	20	17	33
CPR	1.89***				1.21*				2.98***			
Z statistic	2.84				1.75				6.38			

Note. This table reports results from winner-and-loser two-way contingency tests. Winners and losers are determined by a comparison of the alphas of individual funds to the median fund alpha within each style in each period. *WW* denotes winners in two consecutive periods, *LL* denotes losers in two consecutive periods, *WL* denotes winners in the first period and losers in the second period, and *LW* denotes losers in the first period and winners in the second period. CPR (cross-product ratio) is defined as $(WW \times LL)/(WL \times LW)$. The *Z* statistic tests whether the CPR is statistically greater than one. A *Z* statistic of 1.645, 1.960, and 2.575 corresponds to significance at the 10, 5, and 1% levels, respectively. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

TABLE V
Regressions of Performance-Period Alphas on Selection-Period Alphas: January 1990 to August 1998

Performance-Period Six-Factor Alphas = a + b Selection-Period Six-Factor Alphas + e

	1-Year Alphas on 1-Year Alphas	*2-Year Alphas on 2-Year Alphas*
All hedge funds	0.140* (1.419)	0.069* (1.736)
Funds of funds	0.203* (1.539)	0.228** (1.949)
Event-driven funds	−0.075 (−0.629)	0.022 (0.332)
Global-macro funds	0.107* (1.718)	0.172*** (6.251)
Global funds	0.067 (0.408)	−0.018 (−0.372)
Market-neutral funds	0.154* (1.442)	0.196** (2.064)

Note. This table provides averages of the estimated slope coefficients for year-by-year cross-section regressions of performance-period six-factor alphas on selection-period six-factor alphas for 1-year and 2-year selection and performance periods. For each investment style, equations are estimated only if there are at least 20 hedge funds in the cross section. The estimated slope coefficients are treated as a random sample drawn from a normal population, and *t* tests are performed on the time-series means of these coefficients (see Fama & MacBeth, 1973). The *t* statistics are in parentheses. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

of data examined, therefore, investors could have benefited handsomely by using past performance (or alphas) to select hedge funds.[25]

These findings differ somewhat from previous studies of earnings persistence (summarized in Appendix B). Although most studies of mutual funds find some evidence of performance persistence, they generally find that mutual funds have negative excess returns.[26] Even the top-performing mutual funds often have negative alphas. Thus, these findings are qualitatively different from those for hedge funds, for which there is evidence of positive excess returns. The three studies of hedge fund performance persistence, Brown et al. (1999) and Agarwal and Naik (2000a, 2000b), yielded mixed results. Brown et al. used annual returns of offshore hedge funds and did not find evidence of persistence. Agarwal and Naik (2000a, 2000b) found evidence of performance persistence but concluded that this finding was due primarily to repeat

[25]Although not reported in this study, a quintile analysis of performance persistence was also performed. Specifically, in selection periods hedge funds were sorted into quintiles according to their estimated yearly alphas. Funds in Quintile 1 had the highest alphas, and funds in Quintile 5 had the lowest alphas. We then tested in performance periods whether the average alpha of funds in Quintile 1 was statistically greater than the average alpha of all other funds (funds in Quintiles 2–5). Alternatively, we conducted a similar analysis comparing the average performance-period alpha of losers (Quintile 5) to the average performance-period alpha of all other funds (Quintiles 1–4). We again found evidence of performance persistence among both winners and losers. These results can be obtained from the authors on request.

[26]For a discussion of excess returns in mutual funds, see Hendricks et al. (1993), Elton et al. (1993), Goetzmann and Ibbotson (1994), Malkiel (1995), Brown and Goetzmann (1995), Elton et al. (1996), Gruber (1996), and Carhart (1997).

losers rather than repeat winners. In contrast, we find evidence of performance persistence among top-performing hedge funds and among losers. Thus, our findings provide support for the possibility that managerial skill may exist in the hedge fund industry.

CONCLUSION

This study examines hedge fund performance with a multifactor risk model to estimate risk-adjusted excess returns. Using data on the monthly returns of hedge funds during the period January 1990 through August 1998, we estimate six-factor Jensen alphas for individual hedge funds, employing eight different investment styles. We find that, on average, hedge funds earn significantly positive excess returns (8.52% annually) and that these returns differ markedly by investment style, ranging from an annualized excess return of 5.64% for global-macro funds to 15.24% for sector-specific funds. Although only 25% of all hedge funds earn positive excess returns, these funds earn an eye-popping average annualized excess return of 18.72%. Furthermore, the excess returns of these successful funds differ significantly by investment style, ranging from 12.96 to 28.56% annually. In addition, when our estimates of excess returns (six-factor alphas) are compared with other measures of excess returns used in previous studies, we find significant differences in the magnitude of excess returns for different hedge fund investment styles. We also find that incentive fees are positively related to performance. On average, hedge funds that pay incentive fees of 20% or more earn annualized excess returns about 3–6 percentage points higher than funds that pay lower incentive fees. Finally, using both nonparametric and parametric tests, we find evidence of performance persistence among both winning and losing hedge funds, although the evidence of persistence differs significantly by investment style.

Thus, our results are at least consistent with the view that manager skill may exist in hedge funds and that such skill may be a partial explanation for the impressive performance of hedge funds during the 1990s. Some mangers appear to have been able to earn positive excess returns on a consistent basis. Other possible explanations for this impressive performance are that hedge funds may have been able to exploit market inefficiencies because they are less regulated than other money management institutions, such as mutual funds and pension funds (Edwards & Hubbard, 2000), and that fund performance may be enhanced by the ability of hedge funds to use incentive fees to better align the interests of fund managers and investors.

Alternatively, our results may simply be an accident of history. We examined a relatively short 9-year history during the 1990s, a period that saw a remarkable bull market in stocks. A longer history with more diverse markets may be necessary to obtain a more accurate picture of hedge fund performance. Furthermore, to the extent that hedge funds are able to exploit inefficiencies in markets, there is no guarantee that these inefficiencies will continue to exist as more hedge funds seek to exploit them. In the meantime, investors must decide whether or not to invest in hedge funds and in which hedge funds to invest.

APPENDIX A

Managed Account Reports Investment Style Classifications and Definitions

Investment Style	*Definition*
Funds of funds	Capital is allocated among a number of hedge funds, providing investors with access to managers they might not be able to invest on their own. *Diversified:* Allocate capital to a variety of fund types. *Niche:* Allocate capital to a specific type of fund.
Event-driven	Investment theme is dominated by events that are seen as special situations or opportunities to capitalize from price fluctuations. *Distressed securities:* Focus on securities of companies in reorganization and/or bankruptcy. *Risk arbitrage:* Simultaneously buy stock in a company being acquired and sell stock in its acquirers.
Global-macro	Opportunistic funds that invest anywhere they see a value opportunity; attempt to take advantage of macro changes in global economies, particularly major interest-rate shifts; and use leverage and derivatives to enhance positions.
Global	*International:* Focus on economic macro changes around the world (mostly outside of the United States); tend to be stock-pickers in equity markets; use index derivatives but to a lesser extent than macro managers. *Emerging:* Invest in less mature financial markets; because shorting is not permitted in many emerging markets, managers go to cash or other markets when valuations make being long equity unattractive. *Regional:* Focus on specific regions of the world (e.g., Asia, Europe, and Latin America).
Long-only	Traditional equity funds but structured as hedge funds, permitting extensive use of leverage and incentive fees.
Market-neutral	Attempt to lock-out or neutralize market risk by being both long and short. Thus, with greatly reduced market risk, the emphasis is asset selection. *Long/short stock:* Take long and short stock positions to eliminate or reduce exposure to market risk. *Convertible arbitrage:* Go long convertible securities and short underlying equities, profiting from mispricing in the relationship between the two. *Stock arbitrage*: Buy a basket of stocks and short stock index futures, or the reverse. *Fixed-income arbitrage:* Buy bonds, often Treasury bonds, and short other instruments that replicate the purchased bonds in terms of rate and maturity.
Sector-specific	Stock funds that follow specific economic sectors and/or industries.
Short-selling	Short overvalued stocks in the hopes of buying them back at a lower price.

APPENDIX B

Literature on Excess Returns and Performance Persistence in Mutual Funds and Hedge Funds

Study	*Analysis Period*	*Model*	*Excess Returns*	*Performance Persistence*
			Mutual Funds	
Jensen (1968)	1945–1964	CAPM (S&P 500)	Found the annualized average alpha to be −1.1% per year for a broad sample of mutual funds. Treynor (1965) and Sharpe (1966) provided similar results.	Did not test for persistence.
Hendricks et al. (1993)	1974–1988	CAPM for different market indexes (VWCRSP, EW Mutual Fund Index, and EWNYSE)	Found that most of the estimated individual fund alphas were not significantly different from zero. The mean (median) of annualized individual fund alphas is −1.12% (−0.80%) per year when VWCRSP is used as the market index (VWCRSP is the value-weighted index of NYSE and AMEX stocks).	Found evidence of performance persistence in the short run. In cross-section regressions of excess returns on eight quarterly lags, found positive performance persistence for the first four quarters and a reversal thereafter. The difference in alpha between the top and bottom octile portfolios is 6–8% per year.
Elton et al. (1993)	1965–1984	Three-index model (S&P 500, Small Stock Index, and Bond Index)	Found the annualized average alpha to be −1.59% per year and statistically significant at the 1% level. More than two-thirds of the funds have negative alphas.	Divided the sample into two 10-year periods. Formed deciles ranked by alpha in the first 10 years and calculated the average alpha in the second 10-years period for the same deciles. A regression of the second-period alpha on the first-period alpha is significant at the 5% level, indicating persistence.
Goetzmann and Ibbotson (1994)	1976–1988	CAPM (S&P 500)	Did not report the magnitude of Jensen alphas.	Found persistence in Jensen alphas. In a winner-and-loser two-way contingency test, found that 62% of the initial top-half performers (winners) fall in the top half of the sample in the following periods. Also, 63% of the initial bottom-half performers (losers) fall in the bottom half in the following periods.
Malkiel (1995)	1971–1991	CAPM (uses two different indexes: S&P 500 and Wilshire 5000)	For the period 1971–1991, found that the annualized mean alpha is −0.24% per year, which is indistinguishable from zero at the 10% level.	Using winner-and-loser two-way contingency tables, found performance persistence during the 1970s. However, performance persistence in mutual fund returns disappears in the 1980s.

(Continued)

APPENDIX B
(Continued)

Study	*Analysis Period*	*Model*	*Excess Returns*	*Performance Persistence*
			Mutual Funds (Continued)	
			For the 1982–1991 period, found that mutual funds underperform the S&P 500 index (i.e., have negative and statistically significant alphas: −3.20% annualized average excess return).	
Brown and Goetzmann (1995)	1976–1988	1. CAPM (S&P 500) 2. Three-index model (S&P 500, Ibbotson Small Firm Index, and Government Bond Index)	Computed CAPM Jensen alphas for octile portfolios and found that the best performing octile portfolio has an annualized alpha of 4.64%. However, the annualized average alpha of the octile portfolios is 0.36%, which is statistically not different from zero. The results from the three-index model are similar.	Employed winner-and-loser two-way contingency tables and finds evidence of performance persistence. However, most of the persistence is due to repeat losers rather than repeat winners. In an octile analysis, found that the CAPM alpha of the top-octile portfolio is 8.62 percentage points (per year) greater than the alpha of the bottom-octile portfolio.
Elton et al. (1996)	1977–1993	Four-factor model (S&P 500, SMB, HML, and Bond Index)	Found that average fund performance is negative: the 3-year annualized average risk-adjusted return (alpha) is −0.91% per year and statistically significant at the 1% level; the 1-year annualized average risk-adjusted return (alpha) is −0.94% per year and statistically significant at the 5% level.	Differences in the top-decile alpha and either the bottom-decile or average fund alpha are statistically significant at the 1% level. Found performance persistence both in the short run and in the long run. When ranking is done on a risk-adjusted basis, the predictability of performance is increased when performance is measured over a longer period.
Gruber (1996)	1985–1994	1. Absolute excess return over S&P 500 (R_i − S&P 500) 2. CAPM (S&P 500) 3. Four-factor model (S&P 500, SMB, HML, and Bond Index)	Found that mutual funds underperform the market by 1.94% per year in terms of unadjusted returns (absolute excess returns). With a single-factor CAPM, alpha is estimated to be −1.56% per year. The average annualized four-factor alpha is found to be −65 basis points per year.	Found that past performance is predictive of future risk-adjusted performance in the short run and long run. The results show that the four-factor model does better than past raw returns in forecasting future performance.
Carhart (1997)	1962–1993	Four-factor model (S&P 500, SMB, HML, and risk factor	Found that mutual funds do not earn significantly positive risk-adjusted returns: The average annualized four-factor alpha	Found a statistically significant difference in risk-adjusted returns (alpha) between top-and bottom-decile portfolios: 3.36% per year when

		related to momentum)	computed for individual funds is −1.57% per year.	funds are ranked based on raw returns and 5.40% per year when funds are ranked based on 4-factor alphas. In addition, found that common factors in stock returns and investment expenses almost completely explain persistence in raw and risk-adjusted returns.
			Hedge Funds	
Fung and Hsieh (1997)	1991–1995	12-variable factor model (buy-and-hold strategies in nine asset classes and three dynamic trading strategies)	Used factor analysis to determine the dominant hedge fund investment styles and created five different style factors associated with hedge funds. Found that three of the five style factors represent dynamic trading strategies and added these three style factors into nine variable buy-and-hold strategy asset-class-factor model to estimate hedge fund alphas. Using 12-variable-factor model, found reasonably high R^2 values in 40% of hedge funds. Did not report the magnitude of alphas.	Did not test for persistence.
Brown et al. (1999)	1989–1995	1. CAPM (S&P 500) 2. Absolute excess return over the VW style benchmark index ($R_i - R_{vw}$)	Using annual returns data for offshore hedge funds, found positive excess returns (alpha) for all categories of hedge funds, except for short-sellers.	Using both raw and risk-adjusted returns, found that year-by-year cross-section regressions of returns on past returns do not indicate performance persistence. Also did not find performance persistence using two-way winner-and-loser contingency tables.
Ackermann et al. (1999)	1988–1995	CAPM (S&P 500) More emphasis is given to Sharpe ratios.	Found that annualized Jensen alphas are significantly positive for hedge funds and range from 6% to 8% per year for different time periods, except for the period 1994–1995. Did not estimate annualized alphas for alternative investment styles of hedge funds.	Did not test for persistence.
Liang (1999)	1992–1996	Eight-asset-class-factor model (S&P 500, MSCI World Index, MSCI Emerging Markets Index, SBG, SBW, U.S. Fed dollar index, gold price, and 1-month Eurodollar rate)	Estimated alphas for equally weighted hedge fund indexes by using a stepwise regression procedure. Found that hedge fund alphas change by investment style, ranging from −5.22% to 1.26%, with a median of 0.58% a month. Seven out of 16 hedge fund investment styles produce significantly positive alphas.	Did not test for persistence.

(Continued)

APPENDIX B
(Continued)

Study	*Analysis Period*	*Model*	*Excess Returns*	*Performance Persistence*
			Hedge Funds (Continued)	
Agarwal and Naik (2000a)	1982–1998	CAPM (EW Hedge Fund Index)	Used two different excess return measures: alpha and appraisal ratio. Measured alpha as the return of a hedge fund using a particular strategy minus the average return for all hedge funds following the same strategy. Defined the appraisal ratio as the alpha divided by the residual standard deviation resulting from CAPM, a regression of the hedge fund return on the average return of all the hedge funds following that strategy. Did not report the magnitude of the average fund alpha.	Used both parametric (regression-based) and nonparametric (two-way winner-and-loser contingency table) methods to test persistence in alphas and appraisal ratios. Conducted a chi-squared test to compare the observed frequency distribution of repeat winners and repeat losers with the expected frequency distribution. Extended the performance persistence tests from a two-period framework to a multiperiod framework. Found that the extent of persistence decreases as the return measurement interval increases. In addition, persistence is driven more by losers than by winners.
Agarwal and Naik (2000b)	1994–1998	Eight-index model (S&P 500, MSCI World exc. U.S. MSCI Emerging Markets, SBG, SBW, LHY, FRBI, and GP)	Found that hedge funds with different investment styles outperform a benchmark portfolio consisting of a combination of asset classes by 1.56–10.20% per year measured as the HFR index minus the risk-free rate.	Employed both regression and contingency-table methods to test for persistence. Both tests show persistence. The results are driven by repeat losers rather than by repeat winners.
Agarwal and Naik (2000c)	1990–1998	Multifactor model consisting of location factors (buy-and-hold strategies) and dynamic trading strategy factors (option-based strategies)	For each individual fund in the sample, used a stepwise regression approach to ascertain factors that best explain the variation in hedge fund returns. Reported monthly average fund alphas for 10 different hedge fund investment styles and found that average alphas across investment styles range from −1.07% to 1.31% a month, with a mean of 0.88% a month across all individual funds. Taking into account possible survivorship bias in the data, found that 35% of the hedge funds produced positive and significant alphas during the sample period.	Did not test for persistence.

Note. SBG Salomon Brothers government and corporate bond index; SBW Salomon Brothers world government bond index; LHY Lehman high yield composite index; FRBI Federal Reserve Bank trade-weighted dollar index; GP U.K. market price index for gold.

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