Hedge Funds: Risk and Return

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Please note: the content of this paper is under review. Some content is still being refined. This paper is intended to be used for discussion purposes only.

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Abstract

Constructing a data base that is relatively free of bias, this paper provides measures of the returns of hedge funds as well as the distinctly non-normal characteristics of the data. We provide risk-adjusted measures of performance as well as tests of the degree to which hedge funds live up to their claim of market neutrality. We also examine the substantial attrition of hedge funds and analyze the determinants of hedge fund survival as well as perform tests of return persistence. Finally, we examine the claims of the managers of "funds of funds" that they can form portfolios of "the best" hedge funds and that such funds provide useful instruments for individual investors. We conclude that hedge funds are far riskier and provide much lower returns than is commonly supposed.

Hedge funds have become an increasingly popular asset class during the 1990s and early 2000s. Amounts invested in global hedge funds have risen from approximately $50 billion in 1990 to approximately $1 trillion by the end of 2004. Because these funds characteristically employ substantial leverage, they play a far more important role in global securities markets than the size of their net assets indicates. Market makers on the floor of the New York Stock Exchange have estimated that during 2004, trades by hedge funds have often accounted for more than half of the total daily number of shares changing hands. Moreover, investments in hedge funds have become an important part of the asset mix of institutions and even wealthy individual investors.

In this paper, we will first examine the characteristics of the hedge fund universe and the claims made by hedge fund managers regarding their performance over time. We then carefully examine the data bases that have been used to measure hedge fund performance and estimate the magnitude of two substantial biases in the data series. We shall see that these biases are far greater than has been estimated in previous studies.

Constructing a data base that is relatively free of bias, this paper examines the returns of hedge funds as well as the distinctly non-normal characteristics of their returns. We provide risk-adjusted measures of performance as well as tests of the degree to which hedge funds live up to their claim of market neutrality. We also examine the substantial attrition of hedge funds and analyze the determinants of hedge fund survival as well as perform tests of return persistence. Finally, we examine the claims of the managers of "funds of funds" that they can form portfolios of "the best" hedge funds and that such funds provide useful instruments for individual investors.

[Insert Exhibit 1: Growth of Hedge Fund Assets]

Characteristics of Hedge Funds

The term "hedge fund" is applied to a heterogeneous group of investment funds. To the extent that they share any common characteristic it is that, unlike the typical equity mutual fund, they tend to employ substantial leverage, they usually hold both long and short positions, and they often employ complex investment instruments such as derivative securities in their portfolios. Exhibit 2 shows the distribution of hedge fund types according to the TASS database, which we use in this study and which will be fully described below. While these style classifications are largely based on hedge fund managers' reports to TASS, Brown and Goetzmann (2001) determine on the basis of a generalized least squares procedure that "self-classifications […] are indeed reasonably descriptive of TASS hedge fund styles."

The largest group of hedge funds is categorized as Long/Short. These funds have substantial short positions or they employ derivatives to hedge the market risk of their long positions. Some funds in this group explicitly attempt to be "Equity Market Neutral," i.e., to achieve positive returns irrespective of general market movements. Arbitrage strategies aim to exploit mispricings of securities (such as improper relative valuations of convertible bonds and the underlying stocks and bonds) or unusual spreads between the interest rates of various fixed-income securities. These types of funds make heavy use of statistical and mathematical models in an attempt to capture market inefficiencies. Event Driven funds try to capture gains from corporate restructurings or from mergers and acquisitions. Directional strategies are employed by Global Macro, Emerging Markets, Dedicated Short Bias, and Managed Futures funds. These

strategies will attempt to profit from short-term momentum in currency, equity, bond, or commodity price movements and funds following these strategies often describe themselves as trend followers. The Fund of Funds category encompasses managed portfolios of hedge funds that attempt to provide investors with a diversified vehicle intended to match or exceed the industry benchmark. These funds are heavily marketed to high net worth individuals.

One further aspect of the hedge fund industry deserves mention: hedge fund managers are highly compensated. A typical fee arrangement in the industry is to compensate the manager by paying 2 percent of the assets under management plus 20 percent of any profits that are earned. In contrast, the typical mutual fund management fee amounts to 1 ½ percent of the assets or less. Performance incentive fees are not common for mutual fund portfolio managers.

The Putative Case For Hedge Funds

An examination of the aggregate returns of hedge funds that are reported by the major data providers suggests that hedge funds have been a superb asset category during the late 1990s and early 2000s. For example, data provided by Van Hedge Fund Advisors, shown in Exhibit 3, indicates that from 1998 through 2003, hedge funds appear to dominate other investment categories. Exhibit 3 suggests that hedge funds have achieved generous returns and a low standard deviation of returns. As a result, their Sharpe ratio dominates other asset classes such as stocks and bonds. Data such as these convinced Lamm (1999) to entitle his study "Why Not 100% Hedge Funds?" Lamm suggested that a 100 percent allocation to hedge funds was optimal under certain conditions. In addition, hedge funds claim that their returns have low correlations with the general equity market and, therefore, that they are excellent diversifiers.

[Insert Exhibit 2: Categories of Hedge Funds]

**[Insert Exhibit 3: Global Hedge Fund Net Returns
January 1, 1988 – December 31, 2003]**

Biases in Reported Hedge Fund Returns

Several biases exist in the published indexes of hedge fund returns. In this section, we describe these biases and provide measures of the most significant ones.

1. End-of-Life Reporting Bias

Hedge funds generally stop reporting their results during the last several months of their lives. For example, Long-Term Capital Management lost 92 percent of its capital between October 1997 and October 1998. None of these negative returns were reported to the data base providers. Posthuma and van der Sluis (2003) have estimated the bias by assuming that the hedge fund has a negative return in the month after it stopped reporting. According to their calculations, the average industry hedge fund return would be reduced by over 600 basis points per annum if the non-reported last month return was negative 50 percent for funds leaving the data base. This method of adjustment may well improve the accuracy of the various hedge fund indexes but we have chosen to avoid such ad hoc adjustments to the data for two reasons: First, it is possible that some funds stopped reporting not because they failed, but because they did not want to attract new funds. Indeed, Ackerman et al. (1999) argue that many funds with strong results stop reporting because they no longer require the services of a data vendor. Second, we prefer to rely instead on adjustments that can be documented through the use of actual reported

results. We need to recognize, however, that even our adjusted return data are likely to be biased upwards.

2. Backfill Bias

Unlike the data for mutual funds, which must report to regulators and investors their periodic audited returns, hedge funds provide information to the data base publishers only if they desire to do so. Managers often will establish a hedge fund with seed capital and begin reporting their results at some later date and only if the initial results are favorable. Moreover, the most favorable of the early results are then "backfilled" into the data base along with reports of contemporaneous results. Fortunately, data available from TASS Research, a unit of the hedge fund group Tremont Capital Management, indicate when the hedge fund began reporting. Hence, we can examine the backfilled returns and compare them with those returns that were contemporaneously reported. The result should indicate the extent to which the backfilled returns are upwardly biased.

Exhibit 4 compares the yearly returns of the backfilled and contemporaneously reported (non-backfilled) returns as well as providing statistical tests of the differences between the two groups. We note that in the early years (1994 through 1997) the vast majority of the reported returns were backfilled. Only in later years (2001 and later) did the number of non-backfilled returns exceed the number that was backfilled. The Exhibit shows that backfilled returns tend to be substantially higher than the contemporaneously reported ones, particularly in the early years.[1]

[1] The analysis has been done filling in some data when only partial years were reported. When partial year data were the only data available, we filled in the missing partial years by assuming that the fund earned the monthly average of all reporting hedge funds during the missing month. Thus, if we had data available from March through December, we used the average hedge fund return from January and February to calculate an annual return for that fund.

[Insert Exhibit 4: Backfill Bias in Hedge Funds Returns 1994 – 2003]

On average, the backfilled returns are over 500 basis points higher than the contemporaneously reported returns. Using both a test of the difference between the means and medians, we find that the difference between the backfilled and non-backfilled returns is highly significant.[2] The use of backfilled returns to judge the effectiveness of hedge fund management significantly biases the returns upwards.

3. Survivorship Bias

Another important bias in the published hedge fund return indexes is that imparted by survivorship bias. Data bases available at any point in time tend to reflect the returns earned by currently existing hedge funds. They do not include the returns from hedge funds that existed at some time in the past but are presently not in existence or do still exist but no longer report their results. As we shall see below, unsuccessful hedge funds do not tend to survive. It is difficult to obtain new assets for the fund if performance has been poor. Hence, unsuccessful funds tend to close, leaving only the more successful funds in the data base.[3]

In order to examine this phenomenon, we obtained from the TASS reporting service all the past records of funds that are defunct (or for any other reason have stopped reporting) as of April 2004. We refer to these as "dead" funds. Funds that continued to report in 2004 are classified as "live" funds. A comparison of the returns from "live" and "dead" funds is shown in Exhibit 5. The analysis is performed without any backfilled data, which we have shown is substantially upwardly biased.

[2] Only the test for differences between mean returns is reported in Exhibit 4.
[3] As indicated above, it is possible that some hedge funds stopped reporting, not because they were unsuccessful but rather because they did not want to attract new funds. We will examine this possibility below.

Exhibit 5 shows that each year there is a substantial difference between the returns of live and dead hedge funds.[4] Moreover, the data show that there is a substantial attrition rate for hedge funds. For example, there were 604 hedge funds that reported contemporaneous data in 1996. Of those funds, less than 25 percent (124 funds) were still in existence in 2004. Moreover, the mean return for the live funds substantially exceeded the returns from the dead funds. Over the entire 1996 through 2003 period, the average difference between the two groups of hedge funds was almost 750 basis points. In each year, the differences in the two means were highly significant.[5]

It is reasonable to assume that the performance of all hedge funds (both the survivors and the nonsurvivors) is the best reflection of the performance of the hedge fund industry as a whole. We see from the bottom panel of Exhibit 5 that the (arithmetic) average return of the surviving funds was 13.50 percent over the 1996-2003 period. The average return for all funds was only 9.71 percent—a 379 basis point difference. A comparison between our results and the returns published by three index providers, CSFB/Tremont, Van Hedge Advisors, and HFR, is shown in Exhibit 6. The high returns shown by the three index providers most nearly correspond

[Insert Exhibit 5]

[4] Data for 1994 and 1995 were excluded from the analysis because almost all of these data were backfilled rather than contemporaneously reported.

[5] One other aspect of survivorship deserves mention. Suppose a hedge fund with an initial value of $100 increases in value by 10 percent in one year (after payment of management and incentive fees) to $110. During the next year, assume the fund declines by about 10 percent to $100. In year three, assume that it rises to $110. In this case, the manager would not earn another incentive fee for year three's profit. Incentive fees would be payable only on the amount of any increase in the market value of the fund over $110. The $110 figure is referred to as a "high water mark." This explains why there is so much attrition in the industry. If a fund falls sharply so that its asset value is well below its high water mark, the fund manager will be incented to close the fund and open a new one on which any increase in asset value will earn an incentive fee. Moreover, Brown, Goetzmann and Park (2001) find that managers who perform poorly in the first half of a calendar year tend to increase the volatility of the portfolio in the second half of the year. The strategy appears to be that the manager tends to "roll the dice" in an attempt to exceed the high water mark. If they fail to do so, they disband the fund.

[Insert Exhibit 6]

to our results from the TASS data base when only surviving funds are considered and when backfilled returns are included in the analysis. We conclude that despite the claims that they are bias free, the popular hedge fund return indexes are substantially biased upward. Moreover, after correcting for these biases, hedge fund returns appear to be lower than the returns from popular equity indexes and look very similar to the mutual fund returns reported in Exhibit 3 above. During the period spanned by the chart, the S&P 500 stock index earned an average compound annual return of 12.3 percent, slightly higher than the equivalent figure for the backfill-included hedge fund universe.

One possible explanation for the differences in results could be that the comparison hedge fund indexes may be asset weighted rather than equal weighted. All of our averages are equal weighted rather than size weighted, since asset values are available in the TASS data base for only about one half of the funds covered. It is, of course possible, however, that larger funds do better than smaller ones and that by equal weighting we are biasing the industry averages downward. In fact, however, only the CSFB index reported in Exhibit 6 is asset weighted. Both the Van Hedge and HFR indexes are equal weighted. Thus, the weighting convention employed cannot be responsible for our lower estimated returns.

We can, however, examine the effects of weighting on the results. We are able to calculate differences between equal weighted and asset weighted returns for the funds for which asset data exist. From 1996 through 2003, equal weighted returns for those hedge funds reporting assets were 9.33 percent per year. The equivalent asset weighted return for those funds was 9.75 percent, 42 basis points higher. Thus, there is a tendency in our data set for larger

funds to outperform smaller ones. But this analysis suggests that even with asset weighting, the conclusions of this paper would still hold. Moreover, there is essentially no difference in the equal weighted returns of those funds in our sample with and without assets. Thus, there is no reason to believe that even if asset data were available for all funds, our conclusion would change.

It is interesting to compare our estimates of survivorship bias with data obtained from an analysis of mutual funds. Malkiel (1995) found that mutual fund return data were significantly influenced by survivorship bias during the 1980s and early 1990s. Exhibit 7 updates the results of that analysis using data from the same years for which we have data for the hedge funds universe. While survivorship bias is present in both data series, the degree to which the returns from survivors (live funds) exceed those of non-survivors (dead funds) is far greater in the hedge fund universe. The difference in returns comparing all mutual funds (live and dead) with only the surviving funds is 123 basis points compared with the difference of 374 basis points in the case of hedge funds.

[Insert Exhibit 7: Survivorship Bias in Mutual Funds 1996 – 2003]

In Exhibit 8, we show estimates of survivorship bias by hedge fund category. We find substantial differences between live and dead funds in all categories. Interesting, we also find substantial survivorship bias in the "Fund of Funds" category. This contradicts the claim of Lamm (2003) that survivorship bias in the fund of funds category is relatively small.

Our estimates of survivorship bias are considerably larger than those found by other investigators. Measuring the bias as the difference between the returns of all hedge funds and only surviving funds, we find a bias averaging 374 basis points. Estimates of survivor bias by Brown, Goetzman, and Ibbotsen (1999), Brown, Goetzman, and Park (2001), Liang (2000, 2001) and Fung and Hsieh range from 60 basis points to 360 basis points per year for various hedge fund types. In a study covering data during years similar to ours, Amin and Kot (2003) estimate survivorship bias at levels about 200 basis points per year. In a study covering a period prior to ours, Ackerman, McEnally, and Ravenscraft (1999) find estimates of survivorship bias that are small and insignificant.

We believe there are several reasons why our estimates of survivorship bias tend to be higher than those of previous investigators. First, other investigators have used different data sets than we have employed. Liang (2001) states that HFR (the data base provider for some of the previous studies) collects less information on dissolved funds than TASS. Liang finds that his estimates of survivorship bias using the HFR data set are over 160 basis points lower than those found using the TASS data base. Also, the U.S. Offshore Fund Universe data set, used by Brown et al. (1999), reports only annual returns and thus excludes data for funds that stopped reporting during the year, including those funds that died during their year of inception. Even so, they found, on average, a 300 basis point difference between surviving funds and all funds, not too dissimilar to our own estimates. Moreover, we estimate survivorship bias using only

[Insert Exhibit 8: Survivorship Bias by Primary Category 1996-2003]

contemporaneously reported data rather than both contemporaneous and backfilled data. In addition, we use a more recent period than other investigators and our sample size is substantially larger. Finally, since data on "dead" funds are not easily available from the data gathering services, we were particularly diligent in insuring that the TASS service was careful to provide data on *all* hedge funds that stopped reporting during the time period covered by our study.

Persistence in Hedge Fund Returns

Financial consultants characteristically calculate the past investment returns for different hedge fund managers in the belief that past investment success will be a good predictor of future success. We test this hypothesis by asking if winners tend to repeat their success in the subsequent year. We call a "winner" a hedge fund manager who realizes a return larger than the median hedge fund return. A "loser" has realized a below median return. Taking the previous year's winners (156 in 1995), we then ask whether these funds were winners or losers in 1996. It turns out that about 51 percent (80) of the previous year's winners did repeat in 1996. But about 49 percent (76) have below average performance. Performing a Z-test for significance of repeat winning, we find the difference is not significant. Similar results hold over the entire 1996-2003 period. Indeed, the probability of observing repeat winners over the entire period is basically 50-50. Exhibit 9 presents the results.

[Insert Exhibit 9: Persistence in Hedge Fund Returns, 1996-2003]

In the analysis reported in Panel A, we have assumed that any fund that stopped reporting was a loser. It is, of course, possible that funds cease reporting because they do not wish to attract new investments. Thus, in the bottom panel of the Table we do not count funds dropped from the data base as either winners or losers. We find somewhat more persistence (approximately 55 percent of winners repeat) but the results (and significance) vary considerably year by year. We believe, however, that larger funds are more likely to survive and that poor performance is the reason that funds drop from the data base. We undertake a probit analysis below in an attempt to measure the major determinants of survival and to support this assertion.

We can also examine whether more persistence can be shown if we look only at top quartile performers in our data base. In this test we ask if a fund that was a top quartile performer in one year is more likely that not to have a better than average performer in the subsequent year. Exhibit 10 shows than when funds leaving the data base are considered losers, the probability of a top quartile fund in one year being better than average in the next year is only 50 percent.[6]

We have also examined persistence by category of fund. Exhibit 11 presents the data. We note that there is little difference in persistence by category. The Equity Market Neutral category showed the most persistence (61 percent of winners repeat). But in analyzing yearly data we find that in only one year during the 1996-2003 period was the persistence statistically significant.

[Insert Exhibit 10: Persistence of Top Quartile Hedge Fund Performers 1996-2003]

[6] We did test whether the probability of a top quartile performer remaining in the top quartile next year was greater than 25 percent. Here, we could confirm some persistence since about one third of the top quartile performers ended up in top quartile in the following year.

[Insert Exhibit 11]

Past studies tend to find slightly more persistence than are reported above. For example, Agarwal and Naik (2000) examine data from Hedge Fund Research (HFR) from January 1994 to December 1998. They argue that HFR provides data on over 1,000 living and dead hedge funds and does not suffer from survivorship bias. The authors measure a hedge fund's alpha as the return from the hedge fund minus the average return for all hedge funds following the same strategy. Parametric and non-parametric tests were performed to test for quarterly performance persistence. They find reasonable amounts of persistence from quarter to quarter. However, the HFR data base is known to have a lower attrition rate and include far fewer failed funds than other data bases. Moreover, the authors state that the persistence they find is mainly driven by losers being followed by losers rather than winners repeating.

The Non-Normality of Returns

The distribution of hedge fund returns and their distinctly non-normal characteristics have been widely described in the literature. For example, Brooks and Kat (2001) have found that the published hedge fund indexes exhibit relatively low skewness (S) and high kurtosis (K). This is important for investors. Scott and Horvath (1980) have shown that under very weak assumptions with respect to investors' utility functions, investors will prefer high odd moments (mean and skewness) and low even moments (standard deviation and kurtosis). High skewness implies that the distribution of returns is asymmetric with the mean return greater than the

median return.[7] Kurtosis measures the weight of the tails of the returns distribution. High kurtosis indicates that the distribution has "fat" tails. A normal distribution will have a skewness of zero and a kurtosis of 3. Exhibit 12 below shows the standard deviation, skewness, and kurtosis for the various hedge fund categories. The Standard and Poor's 500 stock index is

[Insert Exhibit 12: Descriptive Statistics for Various Hedge Fund Categories 1995 – 2003]

included to show how these higher moments compare with those from general equity investments. While hedge funds do exhibit lower standard deviations than equities, and some categories have somewhat better Sharpe ratios than the S&P 500 stock index, we confirm that hedge fund returns are characterized by undesirably high kurtosis and that many hedge fund categories have considerable negative skewness.

We also undertake the Jarque-Bera[8] (J-B) test of the normality of hedge fund returns. This is a test of the joint hypothesis that S and K are 0 and 3, respectively. The J-B test uses a chi-squared distribution with two degrees of freedom and its statistic is given by:

$$\text{JB} = n\left[\frac{S^2}{6} + \frac{(K-3)^2}{24}\right]$$

where n denotes the number of observations, S is the skewness coefficient, and K is the kurtosis coefficient. The J-B test statistic is reported on the last column of Exhibit 11. With the

[7] Lu and Mulvey (2001) find that hedge funds with positive skewness (since they are more desirable) do tend to have lower rates of return.

[8] See C.M. Jarque and A.K. Bera, "A Test for Normality of Observations and Regression Residuals," *International Statistical Review*, v. 55, 1987, pp. 163-172.

exception of the fund categories "Managed Futures" and "Dedicated Short Bias," the hypothesis of normality is rejected for all the hedge fund categories.

Cross-Sectional Variance and Results for Funds of Funds

Investors need also to be concerned about the cross-sectional distribution of returns. While the distribution of returns over time is clearly important, so is the risk that the investor chooses a particularly poorly performing hedge fund or fund of hedge funds. Of course, the same kind of risk occurs in selecting active equity managers. Thus, we will compare the cross-sectional deviations for all general equity funds as well as for the various categories of hedge funds. Exhibit 13 below displays the results.

[Insert Exhibit 13: Cross-Sectional Standard Deviations by Categories of Funds 1996 – 2003]

We note that the cross-sectional standard deviation of hedge fund returns is considerably higher than is the case for the mutual fund universe. Even the fund of funds category generally displays as high a variance as exists for the entire mutual fund universe. One cannot eliminate the risk of picking a poorly performing hedge fund by buying a diversified fund of funds.

Another way of looking at the cross-sectional variation among hedge-fund returns is to examine the differentials between first quartile and third quartile performance. Exhibit 14 presents the results. In the exhibit we look at the returns of the funds at the bottom of the first and third quartiles when funds are arrayed by average performance over the five-year period from January 1999 through December 2003 and the ten-year period to December 2003. Note that for bond funds and real estate funds there is very little difference between first and third quartile performance. Even for equity funds the differences are relatively modest. For hedge

funds, however, the differences are very large. Moreover, the minimum returns (even allowing for the fact that there is considerable end-of-life bias in the data) are extremely unfavorable. Clearly, there is a risk in investing in hedge funds that is far greater than the risk of investing in the other asset classes covered in the Exhibit. Of course, it is also the case that the rewards from selecting the top performing hedge fund are extremely large as well. This explains why some institutional investors have enjoyed quite satisfactory returns from investing in hedge funds.

[Insert Exhibit 14: Asset Returns by Quartile]

Probit Analysis of the Probability of Fund Survival

We can observe from Exhibit 5 that a substantial proportion of the hedge funds in existence during the late 1990s failed to survive until April 2004. On average, well over 10 percent of all hedge funds die in each year, by which we mean that they stop reporting to the TASS data base service. The attrition rates each year are shown in Exhibit 15. In the exhibit, we compare hedge fund attrition rates to the attrition rates for mutual funds. We find that hedge fund attrition rates are usually three or four times greater and the differences are highly significant.

In this section, we undertake a probit regression analysis to examine the factors that contribute to the probability of a fund's survival, and, by implication, factors that explain its demise. In this analysis, the dependent variable is binary, taking a value of zero if a fund is dead and a value of one if it is still alive; as a consequence, in this probit analysis we are explaining the probability of a fund's survival. The explanatory variables include:

(a) The fund's return in each quarter for the most recent four quarters; they are included as four separate variables. For a fund that died, the most recent quarters are those prior to the period it stopped reporting to the TASS database service. We expect that hedge funds are more likely to die if they have produced low recent returns.

(b) The standard deviation of the fund's return for the most recent year. A higher variability of returns is expected to decrease the probability of fund survival.

[Insert Exhibit 15: Comparison of Hedge Fund Attrition to Mutual Fund Attrition]

(c) The fund's most recent performance relative to all other funds, which is proxied by the number of times in the final three months the fund's monthly return falls below the monthly median return of all hedge funds. Good relative performance should increase a fund's probability of survival.

(d) The fund's size, which is captured by the fund's estimated assets, in billions of dollars, in the most recent month. The larger the size of the fund, ceteris paribus, the more likely we expect it is to survive.

For a fund that died, the most recent quarter or year simply means the period before the fund stopped reporting to the TASS database.

The results of the probit analysis are presented in Exhibit 16. The coefficient estimates suggest that a fund's performance in the most recent quarters is an important determinant of the fund's probability of survival. The coefficient estimate for returns relative to peers is statistically insignificant. Secondly, higher volatility of return (in the most recent year) has a negative impact on a fund's survival probability: the coefficient estimate of the variable, 'standard deviation of

the fund's return for the most recent year' is negative and highly significant. The probit results also suggest that larger funds have a higher probability of survival: the estimated coefficient of the variable 'estimated assets' is positive and significant. Referring back to our discussion of the results reported in Table 9, it would appear that funds that stop reporting to the TASS data base are likely to be "losers" rather than funds that became sufficiently large that they no longer wished to attract new funds.

[Insert Exhibit 16: Probit Regression]

Analysis of Survival Time Analysis for Hedge Funds

In the probit analysis we examined a fund's probability of survival. Here we want to examine a fund's time to survival, that is, the duration of a fund. Duration is defined as the time until failure. For dead funds, this is the time from inception to failure and for funds still alive, duration time is considered truncated since failure has not yet occurred.

Duration data models have been applied extensively to economic and financial analysis in recent years. A few examples of such applications include the length of unemployment (Lancaster, 1979) or welfare spells (Blank, 1989); job duration (Gronberg, 1994)); the length of time firms remain in Chapter 11 protection (Bandopadhaya, 1994); and the duration of marketing time of residential housing (Haurin, 1988). Kiefer (1988) and Lancaster (1990) provide excellent reviews and numerous other examples.

Central to duration analysis is the survivor function:

$$S(t) = Pr(T \geq t)$$

which gives the probability that the random variable T, denoting duration, will equal or exceed the value t. A particularly useful concept in duration analysis is the hazard function:

$$l(t) = -\frac{\dot{S}}{S} = -\frac{dS(t)/dt}{S(t)},$$

which, loosely defined for the purposes of this paper, is the rate at which a fund dies at duration *t*, given that it has lasted until *t*. Thus, the hazard function describes how the rate of failure changes over time. A monotonically increasing (decreasing) hazard function, for example, implies positive duration dependence; in other words, the likelihood of failure increases (decreases) with time. However, in many applications hazard functions can be non-monotonic and can be, for example, U-shaped or inverted U-shaped.

A priori one would expect the hazard function for hedge funds' survival time to be inverted U-shaped. This shape would imply that a fund is unlikely to fail right after inception; if failure occurs, it is likely to occur in the first few years of operation; however, once a fund has survived the first years and has established a track record, its likelihood of failure should decline over time.

Exhibit 17 graphs the hazard functions for the hedge funds in our dataset using the lognormal distribution. The estimated hazard function does show an inverted U-shape, confirming our *a priori* expectation about its shape.[9] Exhibit 17 shows that the failure rate increases for the first year, reaches its peak in the 11th month, and then steadily declines over time. This analysis suggests that the first few years of its existence are critical for a fund's

[9] The functional form of the lognormal hazard implies an inverted U-shape. By contrast, the generalized gamma distribution is extremely flexible and can accommodate a wide variety of hazard function shapes. In this paper, the hazard function was also estimated using the generalized gamma distribution and the inverted U-shape was corroborated by this more flexible functional form. However, based on the Akaike's Information Criterion we rejected the generalized gamma in favor of the lognormal distribution.

survival—if failure occurs, it is most likely to occur in these years. However, the rate of failure (i.e., the hazard rate) stays fairly high for a protracted period of time: between month 12 (when hazard rate reaches its peak) and month 36. During this period, the failure rate drops only by about 18 percent.

Exhibit 18 contains the results of the duration analysis using the same explanatory variables employed in the probit analysis. This analysis examines the role of various factors

[Insert Exhibit 17: Lognormal Hazard Function]

[Insert Exhibit 18: Survival Time Regression]

influencing the survival time of hedge funds.[10] Qualitatively, the results of the probit (survival probability) and duration (survival time) analysis are essentially the same, with one exception. In the duration time analysis, the estimated coefficient of the variable 'peer comparison' (which is the number of times in the final three months the fund's monthly return falls below the monthly median return of all hedge funds) is negative and statistically significant. This result suggests that a fund's survival time is shortened if it performs worse than its peers. The coefficient estimates of the remaining variables all have the expected signs.

The Fund of Funds Category

The product usually marketed to wealthy individual investors is called a Fund of Funds. Like a mutual fund that holds a diversified portfolio of individual equities or bonds, the Fund of

[10] We report the results using the lognormal distribution; the results using the generalized distribution are similar.

Funds holds a diversified portfolio of hedge funds. The fund of funds manager will often claim that the manager can select the best hedge funds for inclusion in the portfolio.

The performance of different Funds of Funds is examined in Exhibit 19. Here, we compare the mean return for the Hedge Fund universe with the mean Fund of Funds return. We note that whether backfilled returns are included or not, and whether dead funds are included or excluded, the mean Fund of Funds return is considerably lower than is the case for the Hedge Fund universe. Clearly, the typical Fund of Funds is not able to select the best performing individual Hedge Funds. Returns are lower for the Fund of Funds category because investors in such portfolios of funds are paying two sets of management fees—one to the Hedge Fund manager and another to the Fund of Funds portfolio manager.

[Insert Exhibit 19: Analysis of Fund of Funds Category]

Hedge Funds and Portfolio Diversification

Perhaps the most frequently made and certainly the strongest argument for the inclusion of hedge funds in an investment portfolio is that they represent an asset class that is uncorrelated with equity investments. For example, Exhibit 20 shows that the various hedge fund categories have very low covariance with the S&P 500 when both hedge fund returns and the S&P are measured contemporaneously. CAPM Betas are very low, measuring 0.231 for the hedge fund universe. The equity market neutral category does indeed have a Beta that is essentially zero and the "short bias" category has a Beta of approximately minus one. With such low measured Betas, hedge funds appear to produce positive alphas, i.e., positive risk adjusted performance.

Measured Betas may be downwardly biased, however, if, as is likely to be the case, hedge fund returns are based on non-synchronous prices. Many hedge funds hold a variety of illiquid and difficult to price securities and derivative instruments. For the purpose of monthly reporting, hedge fund valuation can often be based on recent and estimated prices, rather than prices that are perfectly synchronous with those stocks comprising the S&P 500 stock index. Any lack of synchronicity or "management" of reported returns can lead to biased measures of market exposure.

One technique that has frequently been used to determine a more accurate measure of true Betas is to introduce lags in the estimation process to capture the possibility that hedge fund valuations may be based on stale prices.[11] We run regressions of excess hedge fund returns

[Insert Exhibit 20: Unadjusted and Adjusted Beta Estimates for Hedge Fund Categories]

against not simply contemporaneous excess stock market returns but also on lagged excess stock returns of the following form.

$$(R_{i,t} - R_{F,t}) = a_1 + b_{o,i}(R_{M,t} - R_{F,t}) + b_{1,i}(R_{M,t-1} - R_{F,t-1}) + b_{2,i}(R_{M,t-2} - R_{F,t-2}) + b_{3,i}(R_{M,t-3} - R_{F,t-3}) + e_{i,t}$$

We then calculate the summed Beta $(b_0 + b_1 + b_2 + b_3)$ to obtain a true representation of the hedge fund's true Beta with respect to the stock market index. Exhibit 19 presents the results in

[11] See, for example, Scholes and Williams (1977) and Dimson (1979) as well as Asness, Krail and Liew (2001) who have used the technique to estimate hedge fund Betas.

column (4). Adjusted Betas are considerably higher for the hedge fund universe and increase from 0.231 to 0.393.

Over our sample period 1996-2003, the risk-free rate averaged about 4 percent and the S&P 500 return was 9.4 percent. Using our adjusted Beta, the CAPM equation would then predict a hedge fund return of 6.1 percent.

$$\hat{R}_H = 6.1 = 4.0 + 0.39(9.4 - 4.0)$$

Since the actual return of the hedge fund universe was 9.3 percent, we can say that hedge funds did produce a positive alpha, but one much smaller than those that are obtained using unadjusted Betas.

Concluding Comments

Hedge funds have attracted close to a trillion dollars of investment capital, with most of the growth occurring during the early 2000s. They have been marketed as an asset class that has provided generous returns during all stock market environments and thus as excellent diversifiers to an all equity portfolio.

In this study, we have shown that reported hedge fund results are substantially upward biased. The practice of voluntary reporting (and backfilling only favorable past results) causes some reported hedge fund indexes to be substantially upward biased. Moreover, the substantial attrition that characterizes the hedge fund industry results in substantial survivorship bias in the returns of indexes composed of any currently existing funds. Correcting for such bias we find that hedge funds have lower returns and are riskier than is commonly supposed. Moreover, the reported low correlations of hedge fund returns with standard equity indexes is at least in part an artifact of hedge fund asset pricing that may sometimes rely on stale or managed prices. Even

after correcting for such bias, however, hedge funds do appear to offer investors an asset class that is less than perfectly correlated with standard equity indexes.

Nevertheless, hedge funds have been shown to be extremely risky in another dimension. The cross-sectional variation and the range of individual hedge fund returns are far greater than is the case for traditional asset classes. Investors in hedge funds take on a substantial risk of selecting a very poorly performing fund or worse, a failing one. The industry is characterized by substantial numbers of failures. Moreover, while selection risk can be somewhat mitigated by investing in a diversified "fund of funds," we have shown that these diversified funds perform much less well than the industry as a whole.

Finally, we must wonder whether the substantial flow of funds into the hedge fund industry will tend to reduce returns significantly in the future. When only a limited amount of capital is pursuing arbitrage opportunities between about to merged corporations or between different securities of an individual company, even believers in reasonably efficient markets can image that limited profit opportunities may exist. But as enormous streams of investment funds enter the field, it is reasonable to assume that such opportunities will be attenuated. Thus, the very success of the hedge fund industry in attracting funds is likely to make hedge fund investing a less profitable investment strategy in the future.

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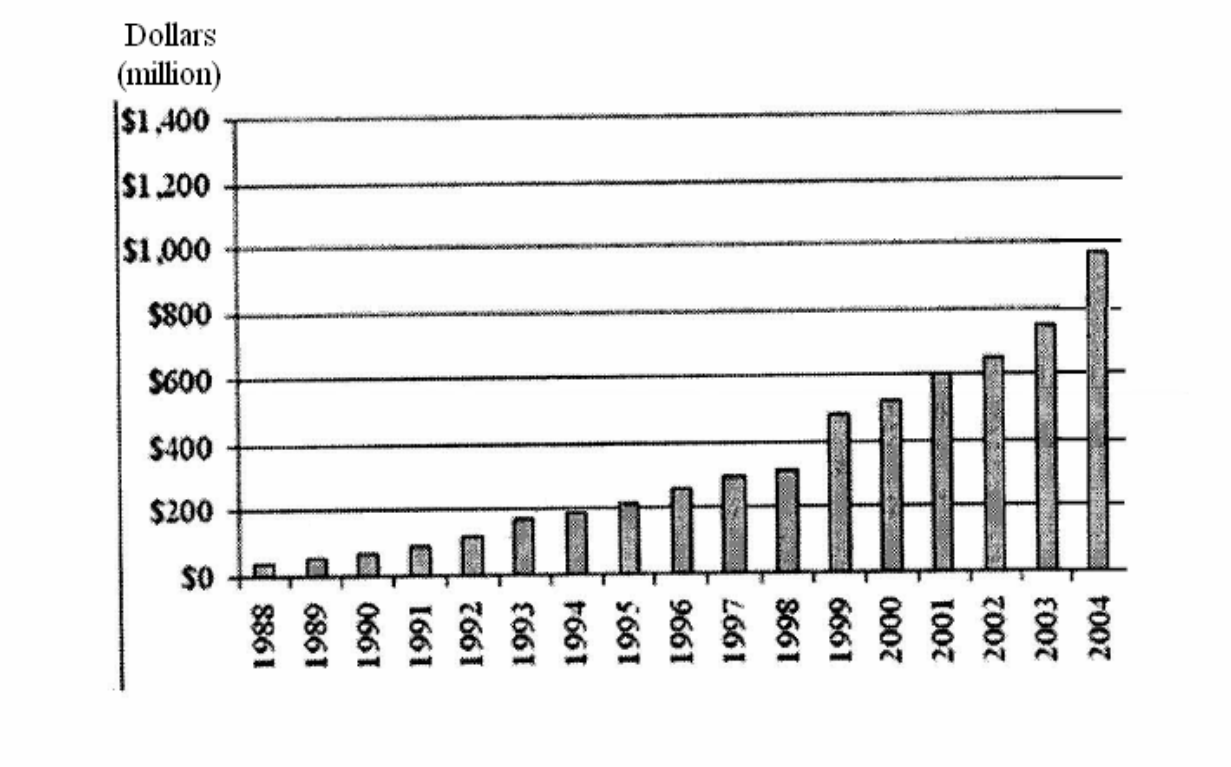
Exhibit 1

Growth of Hedge Fund Assets

The exhibit shows the growth of money invested in hedge funds from 1988 through 2004



Source: Van Hedge Fund Advisors, International and authors' estimates

Exhibit 2

Categories of Hedge Funds

The exhibit shows the distribution of the number of hedge funds across TASS style categories in December 2003

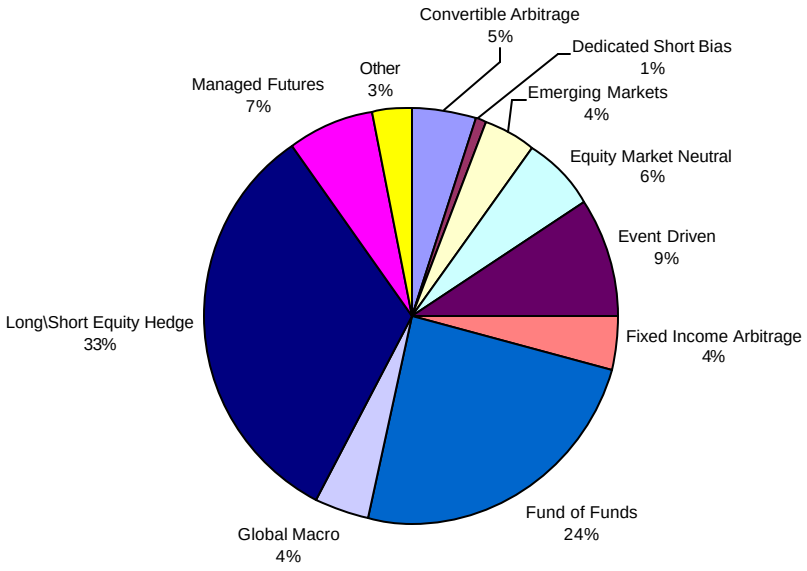


Exhibit 3

Global Hedge Fund Net Returns
January 1, 1988 – December 31, 2003

The exhibit shows hedge fund returns from 1988 through 2003, as estimated by one data gathering service, compared with various stock and bond indexes.

Style/Strategy	Net Compound Annual Return	Standard Deviation	Sharpe Ratio
Van Global Hedge Fund Index	15.9%	11.3%	1.0
MSCI World Equity	5.9%	17.4%	0.1
S&P500	12.3%	18.3%	0.4
Morningstar Average Equity Mutual Fund	9.2%	16.0%	0.3
Lehman Brothers Aggregate Bond Index	8.3%	5.6%	0.6

Source: Van Hedge Fund Advisors

Exhibit 4

Backfill Bias in Hedge Funds Returns 1994 – 2003

This table compares the backfilled returns in the TASS data base with those returns that were contemporaneously reported.

	Backfilled		Non Backfilled			
	Mean Return	**Count**	**Mean Return**	**Count**	**Difference**	**T Stat**
1994	0.39%	1076	-10.81%	22	11.20%	(3.00)
1995	17.98%	1318	11.75%	312	6.23%	(5.13)
1996	19.38%	1298	14.79%	604	4.59%	(4.81)
1997	20.10%	1306	14.05%	786	6.04%	(6.23)
1998	9.68%	1351	-0.56%	1034	10.25%	(10.32)
1999	28.90%	1407	29.18%	1177	-0.28%	0.18
2000	14.16%	1462	3.89%	1293	10.28%	(10.98)
2001	7.91%	1521	3.95%	1971	3.96%	(6.48)
2002	4.93%	949	1.47%	2282	3.46%	(6.84)
2003	19.43%	936	16.76%	2700	2.67%	(1.88)
Average	14.29%		8.45%		5.84%	(5.55)

	Backfilled		Non Backfilled				
	Median	**Count**	**Median**	**Count**	**Difference**	**Z-Stat**	**Probability**
1994	-0.08%	1076	-8.16%	22	8.08%	(3.26)	0.0006
1995	15.92%	1318	11.75%	312	4.17%	(6.20)	<0.0001
1996	17.51%	1298	14.21%	604	3.30%	(7.13)	<0.0001
1997	17.52%	1306	14.21%	786	3.31%	(7.59)	<0.0001
1998	7.75%	1351	2.01%	1034	5.75%	(11.74)	<0.0001
1999	23.60%	1407	18.76%	1177	4.86%	(2.71)	0.0034
2000	11.60%	1462	6.87%	1293	4.73%	(11.10)	<0.0001
2001	6.50%	1521	4.63%	1971	1.87%	8.10	<0.0001
2002	3.12%	949	1.76%	2282	1.36%	7.12	<0.0001
2003	14.90%	936	12.55%	2700	2.35%	6.82	<0.0001
Average	11.83%		7.86%		3.98%	(2.77)	

Source: TASS Database

Exhibit 5

Survivorship Bias in Hedge Fund Returns, 1996 - 2003

This table compares the returns of hedge funds still existing with those funds that left the data base at any time during the 1996-2003 period. Backfilled returns are not included in this analysis. Live/Dead Status determined as of April 2004. The bottom panel presents the comparison of live funds against all funds, live and dead.

	LIVE		DEAD			
Year	**Mean Return**	**Count**	**Mean Return**	**Count**	**Difference**	**T-Stat**
1996	17.23%	124	12.50%	480	4.72%	2.69
1997	19.28%	221	11.23%	565	8.05%	4.97
1998	1.35%	346	-3.46%	688	4.80%	2.91
1999	34.86%	487	24.97%	690	9.89%	3.92
2000	9.14%	649	-3.85%	644	12.99%	10.69
2001	5.63%	1245	-1.85%	726	7.48%	9.90
2002	2.75%	1705	-3.15%	577	5.90%	8.05
2003	17.35%	2343	11.97%	357	5.37%	5.33
Arithmetic Average	**13.45%**		**6.05%**		**7.40%**	**6.06**
Geometric Average	**12.99%**		**5.59%**			

	LIVE		LIVE + DEAD		
Year	**Mean Return**	**Count**	**Mean Return**	**Count**	**Difference**
1996	17.23%	124	13.47%	604	3.75%
1997	19.28%	221	13.49%	786	5.79%
1998	1.35%	346	-1.85%	1034	3.19%
1999	34.86%	487	29.06%	1177	5.80%
2000	9.14%	649	2.67%	1293	6.47%
2001	5.63%	1245	2.87%	1971	2.76%
2002	2.75%	1705	1.26%	2282	1.49%
2003	17.35%	2343	16.64%	2700	0.71%
Arithmetic Average	**13.45%**		**9.70%**		**3.75%**
Geometric Average	**12.99%**		**9.29%**		

Exhibit 6

Comparison of Hedge Fund Returns
1995 – 2003

This table presents the net compounded annual returns of aggregate indices constructed from TASS database with returns from three other public hedge fund indexes.

	TASS - backfill included		TASS – backfill excluded				
	LIVE+DEAD	**LIVE**	**LIVE+DEAD**	**LIVE**	**CSFB/Tremont**	**Van Hedge**	**HFR**
AVERAGE	12.21%	13.75%	9.29%	13.14%	12.62%	13.61%	13.44%

Exhibit 7

Survivorship Bias in Mutual Fund Returns, 1996 - 2003

This table presents the mean return and count of annualized mutual fund returns categorized by their Live/Dead status. This sample includes all general equity funds as reported by Lipper. A fund is categorized as live if it has reported returns as of December 2003. The bottom panel presents the comparison of live funds against all funds, live and dead.

	LIVE		DEAD			
Year	**Mean Return**	**Count**	**Mean Return**	**Count**	**Difference**	**T-Stat**
1996	16.42%	2328	13.32%	1286	3.10%	10.32
1997	18.09%	3123	11.03%	1520	7.05%	14.12
1998	11.41%	3691	4.77%	1705	6.64%	13.32
1999	33.01%	4173	32.08%	1709	0.93%	0.90
2000	-2.28%	4944	-10.17%	1852	7.89%	16.89
2001	-11.26%	5965	-16.52%	1713	5.26%	13.68
2002	-19.46%	7006	-23.58%	1362	4.12%	11.71
2003	31.92%	8416	30.64%	754	1.28%	3.55
Arithmetic Mean	**9.73%**		**5.20%**		**4.53%**	**10.56**

	LIVE		LIVE + DEAD		
Year	**Mean Return**	**Count**	**Mean Return**	**Count**	**Difference**
1996	16.42%	2328	15.32%	3614	1.10%
1997	18.09%	3123	15.78%	4643	2.31%
1998	11.41%	3691	9.31%	5396	2.10%
1999	33.01%	4173	32.74%	5882	0.27%
2000	-2.28%	4944	-4.43%	6796	2.15%
2001	-11.26%	5965	-12.43%	7678	1.17%
2002	-19.46%	7006	-20.13%	8368	0.67%
2003	31.92%	8416	31.81%	9170	0.11%
Arithmetic Mean	**9.73%**		**8.49%**		**1.23%**

Exhibit 8

Survivorship Bias by Primary Category
1996 - 2003

This table presents compound annual returns of hedge fund categories by Live/Dead status. This sample includes non-backfilled data from 1996 through 2003.

	LIVE + DEAD	LIVE	DEAD	Difference LIVE vs. DEAD
Convertible Arbitrage	10.54%	11.53%	6.79%	4.74%
Dedicated Short Bias	1.75%	2.65%	0.45%	2.20%
Emerging Markets	13.32%	20.69%	5.45%	15.24%
Equity Market Neutral	5.46%	6.84%	3.51%	3.33%
Event Driven	9.25%	11.40%	5.57%	5.83%
Fixed Income Arbitrage	7.38%	9.43%	4.29%	5.15%
Fund of Funds	7.14%	8.00%	5.45%	2.55%
Global Macro	7.48%	13.14%	-1.83%	14.97%
Long/Short Equity Hedge	10.71%	13.03%	7.06%	5.97%
Managed Futures	7.07%	11.42%	3.86%	7.55%
Other/Default	10.51%	11.94%	8.27%	3.67%

Exhibit 9

Persistence in Hedge Fund Returns, 1996 - 2003

This table presents tests of persistence in hedge fund returns. This analysis includes non-backfilled returns from 1996 through 2003. In Panel A, funds that stopped reporting are considered losers. In Panel B, funds that stopped reporting are not included in the analysis. The Z-test determines the significance of the persistence against a Chi-square distribution of fifty percent.

Panel A: Dropped Funds Are Considered Losers.

Year	Winner-Winner	Winner-Loser	Total	% Repeat Winner	Z-test Repeat Winner
1996	80	76	156	51.28%	0.3
1997	163	139	302	53.97%	1.4
1998	214	179	393	54.45%	1.8
1999	232	285	517	44.87%	(2.3)
2000	235	354	589	39.90%	(4.9)
2001	403	244	647	62.29%	6.3
2002	539	447	986	54.67%	2.9
2003	447	694	1141	39.18%	(7.3)
				50.08%	**(0.2)**

Panel B: Dropped Funds Are Not Considered in This Analysis.

Year	Winner-Winner	Winner-Loser	Total	% Repeat Winner	Z-test Repeat Winner
1996	80	65	145	55.17%	1.2
1997	163	115	278	58.63%	2.9
1998	214	158	372	57.53%	2.9
1999	232	250	482	48.13%	(0.8)
2000	235	292	527	44.59%	(2.5)
2001	403	202	605	66.61%	8.2
2002	539	354	893	60.36%	6.2
2003	447	605	1052	42.49%	(4.9)
				54.19%	**1.7**

Exhibit 10

Persistence of Top Quartile Hedge Fund Performers
1996 - 2003

The exhibit examines how the previous year's top quartile performers performed in the subsequent year. The analysis includes non-backfilled returns from 1996 through 2003. Funds that stopped reporting are considered losers.

Year	Winner-Winner	Winner-Loser	Total	%Repeat Winner	Z-test Repeat Winners
1996	39	39	78	50.00%	0.00
1997	86	65	151	56.95%	1.71
1998	95	102	197	48.22%	(0.50)
1999	131	128	259	50.58%	0.19
2000	84	210	294	28.57%	(7.35)
2001	188	135	323	58.20%	2.95
2002	297	195	492	60.37%	4.60
2003	260	310	570	45.61%	(2.09)
				49.81%	**(0.06)**

Exhibit 11

Persistence in Hedge Fund Returns by Category of Fund, 1996 - 2003

This table presents the percentage of repeat winners in each category. The figures in the table are an average of yearly repeat winner percentages for each category. Backfilled returns are not included in this analysis. Dropped funds are considered losers.

Type of Fund	% Repeat Winner
Convertible Arbitrage	54.60
Dedicated Short Bias	35.04
Emerging Markets	48.27
Equity Market Neutral	61.26
Event Driven	55.71
Fixed Income Arbitrage	55.64
Fund of Funds	51.74
Global Macro	41.13
Long/Short Equity	51. 67
Managed Futures	42.41
Other	52.08

Exhibit 12

Descriptive Statistics for Various Hedge Fund Categories 1995 - 2003

This table presents descriptive statistics for each of the hedge fund categories and other benchmark indexes. Backfilled data are excluded and both live and dead funds are included. The J-B statistic tests the joint hypothesis that S=0 and K=3.

Categories Aggregate Analysis Summary
1995 - 2003
Live + Dead and Excluding Backfill

	Annual		Monthly		Sharpe			
	Return	St.Dev.	Return	St.Dev.	Ratio	Sknew	Kurtosis	J-B Stat
Convertible Arbitrage	11.62%	5.02%	0.93%	1.20%	1.48	(1.51)	10.94	321.46
Dedicated Short Bias	-1.77%	15.67%	-0.06%	6.07%	(0.38)	0.41	3.63	4.81*
Event Driven	9.85%	26.80%	0.68%	5.08%	0.21	(1.28)	8.03	141.91
Emerging Markets	7.81%	4.33%	0.64%	0.80%	0.83	0.69	4.99	26.27
Equity Markets Neutral	10.52%	7.76%	0.83%	1.60%	0.81	(1.57)	10.83	317.32
Fixed Income Arbitrage	6.66%	7.89%	0.53%	1.36%	0.31	(2.47)	13.42	592.83
Fund of Funds	7.02%	7.44%	0.56%	1.74%	0.38	(0.14)	6.31	49.13
Global Macro	7.34%	8.55%	0.59%	2.02%	0.37	0.75	4.22	16.60
Long/Short Bias Hedge	14.83%	15.49%	1.14%	2.96%	0.69	0.13	4.87	15.89
Managed Futures	5.54%	6.61%	0.47%	2.80%	0.20	0.10	2.86	0.26*
Other	9.32%	9.41%	0.74%	1.91%	0.54	(2.25)	17.96	1088.70
Hedgefund Universe	8.82%	9.21%	0.70%	1.99%	0.50	(0.25)	5.51	29.09
CSFB	13.41%	10.36%	1.05%	2.45%	0.89	0.07	4.90	16.20
S&P500	12.38%	21.69%	0.93%	4.70%	0.38	(0.64)	3.28	7.62
T-Bill	4.20%	1.78%	0.34%	0.14%	0.00	(0.89)	2.20	16.98
Normal (μ,σ)	μ	σ				0.00	3.00	0.00

Note:
The J-B Test statistic is distributed as chi-squared, with 2 degrees of freedom. Asterisk indicates that hypothesis of normality cannot be rejected at the 5% level. (Critical value = 5.99)

Exhibit 13

Cross-Sectional Standard Deviations by Categories of Funds
1996 – 2003

This table presents the cross-sectional standard deviation of returns for each category in the hedge fund universe. This sample includes non-backfilled returns from 1996 through 2003 for both live and dead funds. Each yearly figure represents the average of monthly cross-sectional standard deviation for each category. The final average figure is the average of all the yearly cross-sectional standard deviations.

	1996	1997	1998	1999	2000	2001	2002	2003	YEARLY AVERAGE
Convertible Arbitrage	1.62%	2.01%	2.43%	2.10%	2.73%	2.11%	1.97%	1.65%	**2.08%**
Dedicated Short Bias	5.27%	3.84%	7.06%	5.84%	5.18%	6.68%	3.70%	2.85%	**5.05%**
Emerging Markets	5.89%	6.22%	9.82%	8.63%	7.30%	5.45%	5.30%	4.59%	**6.65%**
Equity Markets Neutral	2.88%	2.48%	3.32%	3.13%	3.20%	3.45%	2.69%	2.43%	**2.95%**
Event Driven	4.33%	2.85%	3.71%	3.69%	4.48%	3.37%	2.71%	2.28%	**3.43%**
Fixed Income Arbitrage	1.96%	1.85%	4.32%	2.26%	3.36%	3.38%	3.14%	1.79%	**2.76%**
Fund of Funds	3.22%	3.84%	4.61%	4.04%	4.20%	2.45%	2.02%	1.91%	**3.29%**
Global Macro	5.17%	5.43%	7.78%	4.90%	5.72%	5.79%	4.67%	4.38%	**5.48%**
Long/Short Bias Hedge	5.44%	5.28%	6.78%	7.19%	8.57%	5.98%	4.28%	3.49%	**5.88%**
Managed Futures	8.65%	6.98%	6.25%	6.14%	6.53%	4.78%	6.33%	5.21%	**6.36%**
Other	2.86%	3.96%	5.62%	5.04%	4.56%	3.67%	4.20%	4.46%	**4.29%**
Hedge Fund Universe	5.82%	5.39%	7.04%	6.36%	6.83%	5.17%	4.26%	3.58%	**5.56%**
Mutual Fund Universe	2.53%	2.74%	3.11%	3.87%	5.48%	3.85%	3.05%	2.09%	**3.34%**

Exhibit 14

Asset Returns by Quartile

This table presents a comparison of the differences between the bottoms of the first and third quartile returns for various investment categories. The top panel presents the variation over the five years ending December 2003. The bottom panel presents the variation over the 10 years ending December 2003.

5 Years Ending 12/31/2003

	Max (%)	1st Quartile (%)	Median (%)	3rd Quartile (%)	Min (%)	Range of 1st-3rd Quartiles
US Fixed Income	9.3	7.2	6.9	6.5	3.8	0.7
US Equity	11.3	4.2	1.2	-0.4	-5.1	4.6
International Equity	21.9	8.0	4.0	1.5	-5.8	6.6
Real Estate	10.2	9.9	9.2	8.2	7.3	1.8
Hedge Funds	160.2	11.1	4.0	-4.5	-79.3	15.6

10 Years Ending 12/31/2003

	Max (%)	1st Quartile (%)	Median (%)	3rd Quartile (%)	Min (%)	Range of 1st-3rd Quartiles
US Fixed Income	8.4	7.4	7.2	7.0	6.0	0.5
US Equity	17.6	12.6	11.7	11.2	6.9	1.4
International Equity	12.5	9.3	7.0	5.2	2.1	4.1
Real Estate	12.9	11.3	10.4	9.5	9.0	1.8
Hedge Funds	236.8	14.6	6.0	-2.1	-85.5	16.7

Exhibit 15

Comparison of Hedge Fund Attrition to Mutual Fund Attrition

	Hedge Fund Attrition (TASS database)			Mutual Fund Attrition			
Year	**Existing**	**Exiting**	**Attrition**	**Existing**	**Exiting**	**Attrition**	**Chi-Square**
1994	22	3	**13.64%**	2,407	61	**2.53%**	**10.47**
1995	312	30	**9.62%**	3,037	152	**5.00%**	**11.70**
1996	604	89	**14.74%**	3,614	139	**3.85%**	**120.00**
1997	786	86	**10.94%**	4,643	188	**4.05%**	**66.63**
1998	1,034	154	**14.89%**	5,396	281	**5.21%**	**129.07**
1999	1,177	176	**14.95%**	5,882	319	**5.42%**	**136.60**
2000	1,293	229	**17.71%**	6,796	521	**7.67%**	**130.29**
2001	1,971	265	**13.44%**	7,678	597	**7.78%**	**61.97**
2002	2,282	261	**11.44%**	8,368	663	**7.92%**	**27.95**
2003	2,700	378	**14.00%**	9,170	752	**8.20%**	**81.44**

Note: Backfilled returns were excluded from the dataset. Therefore, only funds reporting contemporaneously were considered.

Exhibit 16

Probit Regression
Explained Variable: Probability of Fund Survival

The regression explains probability that a hedge fund will survive. The explanatory variables are described below.

	Explanatory Variables	Coefficient	Std Dev	z	P>|z|
[1]	Quarter 1	1.21	0.39	3.10	0.00
[2]	Quarter 2	4.40	0.35	12.53	0.00
[3]	Quarter 3	3.46	0.37	9.45	0.00
[4]	Quarter 4	2.02	0.31	6.49	0.00
[5]	Standard Deviation for final 12 months	(15.40)	0.96	(16.07)	0.00
[6]	Peer Comparison	(0.05)	0.04	(1.41)	0.16
[7]	Estimated Assets	0.91	0.19	4.87	0.00
[8]	Constant	0.89	0.08	11.51	0.00

Explanation of Variables:

[1] Return for the first quarter before the end of fund performance (Months 1 - 3)
[2] Return for the second quarter before the end of fund performance (Months 4 - 6)
[3] Return for the third quarter before the end of fund performance (Months 7 - 9)
[4] Return for the fourth quarter before the end of fund performance (Months 10 - 12)
[5] Standard deviation for the year prior to the end of fund performance (Months 1 - 12)
[6] Number of times in the final 3 months the fund's monthly return falls below the monthly median of all funds
[7] Estimated assets of the fund at the end of performance. If estimated assets are missing for the final month, the amount of estimated assets in the final four months is used as a substitute. Estimated assets are in billions of dollars.

Exhibit 17
Lognormal Hazard Function

The graph shows the rate at which a hedge fund dies given that it has lasted the number of months shown on the horizontal axis.

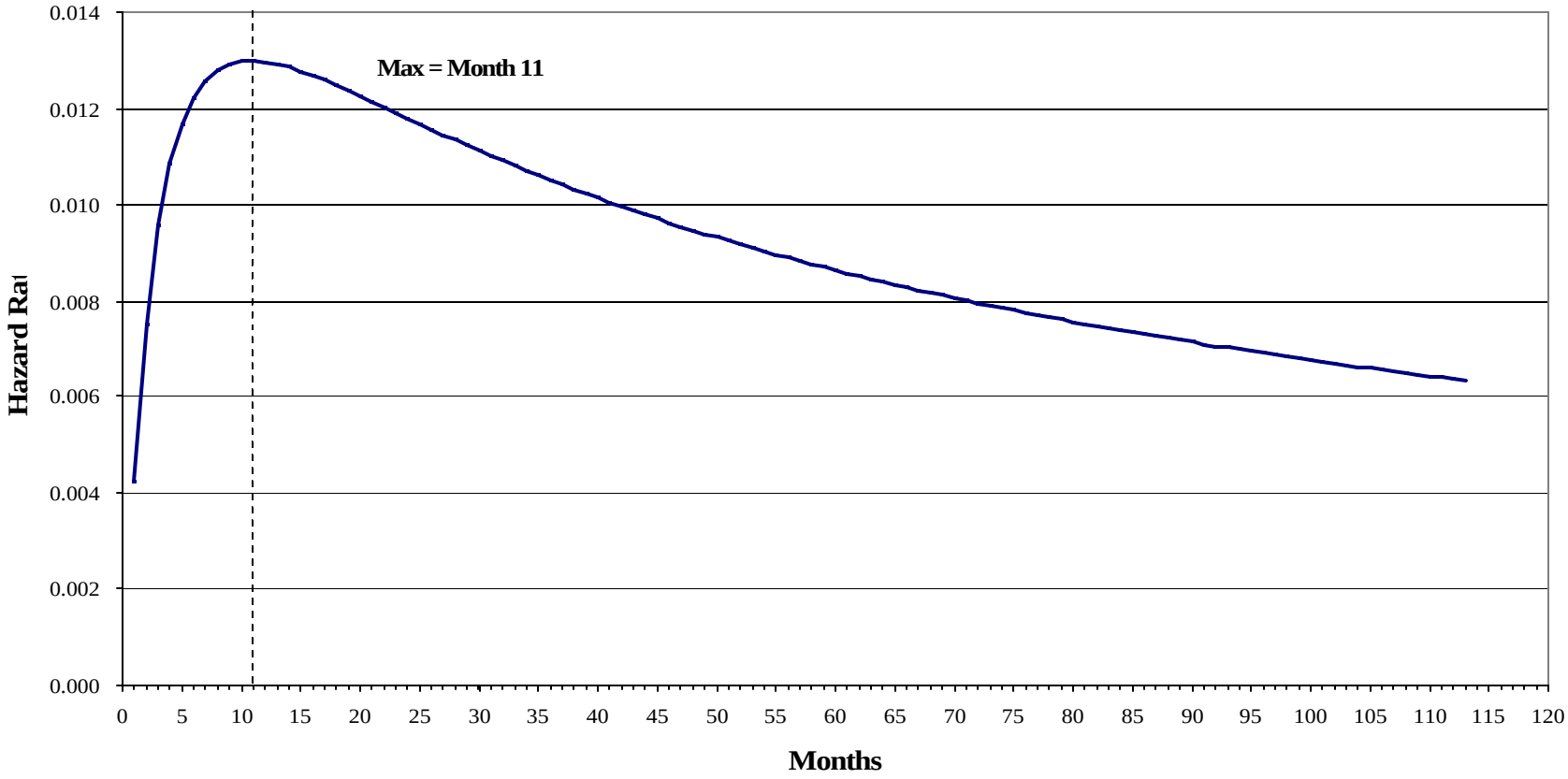


Exhibit 18

Survival Time Regression
Duration Analysis - Lognormal

The regression explains the survival time for hedge funds. The explanatory variables are described below.

	Explanatory Variables	Coefficient	Std Dev	z	P>|z|
[1]	Quarter 1	0.24	0.20	1.19	0.24
[2]	Quarter 2	1.19	0.20	6.08	0.00
[3]	Quarter 3	1.40	0.18	7.89	0.00
[4]	Quarter 4	0.88	0.16	5.38	0.00
[5]	Standard Deviation for final 12 months	(3.41)	0.45	(7.53)	0.00
[6]	Peer Comparison	(0.10)	0.03	(3.69)	0.00
[7]	Estimated Assets	1.07	0.15	7.30	0.00
[8]	Constant	4.37	0.06	74.99	0.00

Explanation of Variables:

[1] Return for the first quarter before the end of fund performance (Months 1 - 3)
[2] Return for the second quarter before the end of fund performance (Months 4 - 6)
[3] Return for the third quarter before the end of fund performance (Months 7 - 9)
[4] Return for the fourth quarter before the end of fund performance (Months 10 - 12)
[5] Standard deviation for the year prior to the end of fund performance (Months 1 - 12)
[6] Number of times in the final 3 months the fund's monthly return falls below the monthly median of all funds
[7] Estimated assets of the fund at the end of performance. If estimated assets are missing for the final month, the amount of estimated assets in the final four months is used as a substitute. Estimated assets are in billions of dollars.

Exhibit 19

Analysis of Fund of Funds Category
1996 - 2003

The table shows the mean monthly return for the fund of funds category compared with the mean return for the hedge fund universe.

Backfill Excluded & Live + Dead

Fund of Funds			Hedge Fund Universe				
Mean	Stdev	Count	Mean	Stdev	Count	Difference	T-stat
0.50%	0.62%	375	0.75%	1.06%	1649	-0.25%	(5.97)

Backfill Excluded & Live Only

Fund of Funds			Hedge Fund Universe				
Mean	Stdev	Count	Mean	Stdev	Count	Difference	T-stat
0.58%	0.47%	243	0.95%	0.87%	1034	-0.37%	(9.00)

Backfill Included & Live + Dead

Fund of Funds			Hedge Fund Universe				
Mean	Stdev	Count	Mean	Stdev	Count	Difference	T-stat
0.62%	0.55%	610	0.98%	0.97%	2498	-0.36%	(12.04)

Backfill Included & Live Only

Fund of Funds			Hedge Fund Universe				
Mean	Stdev	Count	Mean	Stdev	Count	Difference	T-stat
0.66%	0.43%	459	1.06%	0.88%	1860	-0.39%	(13.61)

Exhibit 20

Unadjusted and Adjusted Beta Estimates for Hedge Fund Categories

The table shows adjusted and unadjusted beta estimates for various hedge fund categories. Monthly individual excess hedge fund returns are regressed against the excess returns for the S&P 500 index. The numbers shown for each category are the averages from the individual regressions. Backfilled returns are excluded from the analysis. Funds with less than 24 observations are excluded from the analysis.

		(1) Contemporaneous		(2) Lagged Betas				(3) Sum of Lagged Betas	(4)
	observations	a (t)	b (t)	b 0(t)	b 1(t-1)	b 2(t-2)	b 3(t-3)	(b 0+b 1+b 2+b 3)	b Difference
Convertible Arbitrage	84	6.84%	0.088	0.090	0.080	0.007	0.000	0.178	0.090
Dedicated Short Bias	13	0.80%	(0.957)	(0.953)	(0.142)	0.047	(0.082)	(1.132)	(0.175)
Emerging Markets	148	4.96%	0.641	0.657	0.214	0.003	(0.022)	0.852	0.211
Equity Market Neutral	100	3.74%	(0.015)	(0.010)	0.012	0.035	0.005	0.043	0.057
Event Driven	189	4.92%	0.179	0.182	0.112	0.044	0.027	0.365	0.185
Fixed Income Arbitrage	80	3.07%	0.025	0.037	0.050	0.076	0.032	0.194	0.169
Fund of Funds	375	2.06%	0.142	0.146	0.053	0.059	0.029	0.287	0.146
Global Macro	92	1.71%	0.042	0.054	0.062	0.093	(0.006)	0.203	0.161
Long/Short Equity Hedge	717	6.74%	0.422	0.425	0.114	0.057	0.047	0.642	0.220
Managed Futures	183	2.35%	(0.154)	(0.152)	(0.044)	0.026	0.036	(0.133)	0.021
Other/Default	43	3.79%	0.270	0.266	0.075	0.008	0.067	0.417	0.146
Hedge Fund Universe	2024	3.68%	0.231	0.235	0.082	0.047	0.028	0.393	0.162