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Hedge Funds: Risk and Return

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Since the early 1990s, hedge funds have become an increasingly popular asset class. The amount invested globally in hedge funds rose from approximately $50 billion in 1990 to approximately $1 trillion by the end of 2004.[1] And because these funds characteristically use substantial leverage, they play a far more important role in the global securities markets than the size of their net assets indicates. Market makers on the floor of the NYSE have estimated that during 2004, trades by hedge funds 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.

We examine a reasonably comprehensive database of hedge fund returns and estimate the magnitude of two substantial biases that can influence measures of hedge fund performance in the data series. The reader will see that these biases may be far greater than has been estimated in previous studies. In this article, we discuss our construction of a database that is relatively free of bias and examine not only the returns of hedge funds but also the distinctly nonnormal characteristics of their returns. We also investigate the substantial attrition of hedge funds, analyze the determinants of hedge fund demise, and provide the results of tests of return persistence.

The TASS Database

We used the database provided by TASS, a unit of Tremont Capital Management, to study the characteristics of hedge fund returns. The TASS database covers between one-third and one-half of the total number of hedge funds in existence. The number of funds covered in each category each year is given in the tables.[2] Of course, the funds not included in the TASS database may have different characteristics from the funds reported to TASS, but when the TASS service was purchased by Tremont in March 1999, Tremont endeavored to get those hedge funds that reported to Tremont and other database services to begin reporting to TASS. As a result, during the early 2000s, TASS became one of the most comprehensive reporting services. It covers all varieties of hedge funds, and we believe it is broadly representative of the hedge fund universe.[3] We obtained TASS data not only on currently existing funds but also on so-called dead, graveyard, or defunct funds (i.e., funds that either are no longer in existence or have stopped reporting to the TASS service).

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Nonnormality of Returns

The distribution of hedge fund returns and their distinctly nonnormal characteristics have been widely described in the literature. For example, Brooks and Kat (2002) found that the published hedge fund indices exhibit relatively low skewness and high kurtosis. This combined characteristic is important for investors. Scott and Horvath (1980) showed that under very weak assumptions with respect to investors' utility functions, investors will prefer high first and third moments (mean and skewness) and low second and fourth moments (standard deviation and kurtosis). High skewness implies that the distribution of returns is asymmetrical, with the mean return greater than the median return.[4] Kurtosis measures the size of the tails of the returns distribution. High kurtosis indicates that the distribution has "fat" tails. A normal distribution will have a skewness of 0 and a kurtosis of 3.

Table 1 shows returns, standard deviations, skewness, and kurtosis for the various hedge fund categories compared with these summary statistics for various other asset classes and indices. Although the hedge fund universe does exhibit lower standard deviation than equities, as represented by the S&P 500 Index, and some categories have somewhat better Sharpe ratios than the S&P 500, Table 1 confirms that hedge fund returns are characterized by undesirably high kurtosis and that many hedge fund categories have considerable negative skewness. Results of a Jarque–Bera (J–B) test of the normality of hedge fund returns is reported in the last column of Table 1.[5] The hypothesis of normality is rejected for all the hedge fund categories except managed futures and global macro.

Table 1. Descriptive Statistics for Various Hedge Fund Categories, 1995–2003

	Annual		Monthly					
Fund Type	Return	Standard Deviation	Return	Standard Deviation	Sharpe Ratio	Skewness	Kurtosis	J–B Statistic
Convertible arbitrage	11.42%	15.56%	0.86%	1.40%	0.46	–0.50	6.61	63.37*
Dedicated short bias	–0.01	23.82	0.25	5.75	–0.18	0.65	4.15	12.07*
Emerging markets	14.19	44.09	0.71	5.06	0.23	–0.66	5.11	27.90*
Equity market neutral	5.56	13.08	0.57	0.93	0.10	–0.62	4.22	13.70*
Event driven	9.71	17.73	0.83	1.58	0.31	–1.50	10.61	301.00*
Fixed-income arbitrage	7.04	17.70	0.58	1.08	0.16	–2.03	9.16	244.98*
Fund of funds	6.67	15.97	0.51	1.79	0.15	–0.13	6.43	53.19*
Global macro	6.79	24.15	0.38	2.03	0.11	0.09	3.00	0.14
Long–short equity hedge	10.33	29.91	1.01	2.89	0.20	–0.09	4.34	8.26*
Managed futures	7.68	23.22	0.51	2.49	0.15	0.09	2.87	0.23
Other	11.42	29.71	0.75	1.79	0.24	–1.28	8.57	169.06*
Hedge fund universe	8.82	9.21	0.70	1.99	0.50	–0.25	2.51	29.36*
CSFB	13.41	10.36	1.05	2.45	0.89	0.07	1.90	16.36*
S&P 500	12.38	21.69	0.93	4.70	0.38	–0.64	0.28	7.69*
U.S. T-bill	4.20	1.78	0.34	0.14	0.00	–0.89	–0.80	17.14*

Notes: Backfilled data were excluded; live and defunct funds were included. The Sharpe ratio was measured as excess return divided by standard deviation of return. The J–B (Jarque–Bera) statistic tests the joint hypothesis that skewness = 0 and kurtosis = 3. The Sharpe ratio is based on annual data; kurtosis and skewness are based on monthly data.

*Significant at the 5 percent or better level of confidence (critical value = 5.99).

Biases in Reported Hedge Fund Returns

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

Backfill Bias. Unlike mutual funds, which must report their periodic audited returns to regulators and investors, hedge funds provide information to the database publishers only if they desire to do so. Managers often 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 "filled back" into the database together with reports of contemporaneous results. This first source of backfill bias is often called "incubation bias."

Our measure of backfill bias includes incubation bias and also a second source of bias. A fund may have previously reported to another database, but when the fund began reporting to TASS, it may not have reported all the previous data that were given to the other service. It may have provided TASS only the data it would like potential investors to see. Fortunately, TASS indicates when a hedge fund began reporting, so we were able to examine the backfilled returns and compare them with those returns that were contemporaneously reported to TASS. The result should indicate the extent to which the backfilled returns were upwardly biased.

Table 2 compares the yearly returns of the backfilled and contemporaneously reported (not backfilled) returns and statistical tests of the differences (given in percentage points) between the two groups. Note that in the early years, especially 1994 and 1995, the vast majority of the reported returns were backfilled. Only in later years (2002 and later) did the number of returns not backfilled exceed the number that was backfilled. Table 2 shows that backfilled returns tended to be substantially higher than contemporaneously reported returns, particularly in the early years.[6] On average, the backfilled returns were more than 500 bps higher than the contemporaneously reported returns. Using tests of the difference between the means and between the medians, we found the differences between backfilled and not backfilled returns to be highly significant. Thus, we conclude that the use of backfilled returns to judge the effectiveness of hedge fund management significantly biases the returns upwards.

Survivorship Bias. Another important bias in the published hedge fund return indices is survivorship bias. Databases available at any point in time tend to reflect the returns earned by currently existing hedge funds. They do not include the returns

Table 2. Backfill Bias in Hedge Fund Returns, 1994–2003

	Backfilled		Not Backfilled			
Year	Return	Count	Return	Count	Difference in Means	*t*-Statistic
A. Means						
1994	0.42%	1,076	–11.53%	22	11.96 pps	–3.41*
1995	17.23	1,318	10.37	52	6.85	–2.04*
1996	19.44	1,299	12.37	331	7.08	–5.28*
1997	19.81	1,307	13.09	555	6.72	–5.91*
1998	9.62	1,352	–2.04	751	11.65	–9.84*
1999	31.50	1,408	28.19	913	3.32	–1.48
2000	14.69	1,463	2.08	1,030	12.62	–12.13*
2001	8.24	1,522	2.81	1,119	5.43	–6.65*
2002	6.10	950	0.88	1,747	5.22	–8.35*
2003	19.49	936	17.20	2,065	2.29	–1.24
Arithmetic mean	14.65%		7.34%		7.31 pps	–5.63*
Geometric mean	14.35		6.81			
B. Medians						
					Difference in Medians	χ^2
1994	0.00%	1,076	–8.76%	22	8.76 pps	11.87*
1995	15.31	1,318	5.74	52	9.57	13.51*
1996	17.12	1,299	11.30	331	5.81	55.50*
1997	17.85	1,307	12.31	555	5.54	56.99*
1998	9.19	1,352	–0.51	751	9.70	142.87*
1999	20.24	1,408	18.32	913	1.91	3.92*
2000	12.80	1,463	4.35	1,030	8.45	133.05*
2001	7.16	1,522	3.98	1,119	3.18	72.74*
2002	4.60	950	0.98	1,747	3.62	77.48*
2003	12.64	936	11.79	2,065	0.85	2.05
Arithmetic mean	11.69%		5.95%		5.74 pps	57.00*
Geometric mean	11.52		5.69			

*Significant at the 5 percent or better level of confidence.

from hedge funds that existed at some time in the past but are presently not in existence (i.e., the truly "dead" funds) or exist but no longer report their results (the defunct funds). Unsuccessful hedge funds have difficulties obtaining new assets. Hence, they tend to close, leaving only the more successful funds in the database.[7] But some funds stop reporting not because they are unsuccessful but because they do not want to attract new investment.

To examine survivorship bias, we obtained from TASS all the past records of funds that for any reason had stopped reporting as of April 2004. We use the term "defunct" to include dead as well as defunct funds. Funds that continued to report in 2004 we classified as "live" funds. A comparison of the returns of live funds with those of defunct funds is shown in Panel A of **Table 3**. This analysis was performed without backfilled data, which we have shown is substantially upwardly biased.[8]

Panel A shows a substantial difference each year between the returns of live hedge funds and returns of defunct funds. The mean return for the live funds substantially exceeds the return from the defunct funds. For the entire 1996–2003 period, the average difference between the two groups of hedge funds is more than 830 bps. In each year, the differences in the two means are highly significant.[9] Moreover, the data show a substantial attrition rate for hedge funds. For example, 331 hedge funds were reporting contemporaneous data in 1996. Of those funds, fewer than 25 percent (58 funds) were still in existence in 2004.

A reasonable assumption is that the performance of all hedge funds (both the live and the defunct) is the best reflection of the performance of the hedge fund industry as a whole. A comparison of the performance of live funds with the performance of the whole industry defined this

Table 3. Survivorship Bias in Hedge Fund Returns, 1996–2003

Year	Mean Return	Count	Mean Return	Count	Difference in Means	*t*-Statistic
A. Live vs. defunct funds						
	Live		Defunct			
1996	17.27%	58	11.32%	273	5.95 pps	2.20*
1997	19.41	138	10.99	417	8.42	3.48*
1998	2.18	232	–3.92	519	6.11	2.99*
1999	34.09	361	24.33	552	9.76	3.71*
2000	9.39	504	–4.94	526	14.33	10.12*
2001	7.11	678	–3.79	441	10.89	9.04*
2002	2.48	1,273	–3.40	474	5.87	6.86*
2003	17.98	1,770	12.53	295	5.45	4.56*
Arithmetic mean	13.74%		5.39%		8.35 pps	5.37*
Geometric mean	13.31		4.91			
B. Live vs. live + defunct funds						
	Live		Live + Defunct			
1996	17.27%	58	12.37%	331	4.91 pps	
1997	19.41	138	13.09	555	6.32	
1998	2.18	232	–2.04	751	4.22	
1999	34.09	361	28.19	913	5.90	
2000	9.39	504	2.08	1,030	7.32	
2001	7.11	678	2.81	1,119	4.29	
2002	2.48	1,273	0.88	1,747	1.59	
2003	17.98	1,770	17.20	2,065	0.78	
Arithmetic mean	13.74%		9.32%		4.42 pps	
Geometric mean	13.31		8.91			

Note: Backfilled returns were not included in this analysis; live versus defunct status was determined as of April 2004.

*Significant at the 5 percent or better level of confidence.

way is provided in Panel B of Table 3. The (arithmetic) average return of the surviving funds was 13.74 percent for the 1996–2003 period, whereas the average return for all funds was only 9.32 percent—a 442 bp difference.[10]

A comparison of our estimates of survivorship bias with data obtained from an analysis of mutual funds is interesting. Malkiel (1995) found that mutual fund return data were significantly influenced by survivorship bias during the 1980s and early 1990s. **Table 4** updates the results of that analysis with data from the same years for which we had data for the hedge fund universe. Comparison of Tables 3 and 4 shows that, although survivorship bias is present in both data series, the degree to which the returns from survivors (live funds) exceed those of nonsurvivors (defunct funds) is far greater in the hedge fund universe. The difference in returns when all funds (live and defunct) were compared with only live funds (Panel B of each table) is 123 bps for the equity mutual funds but 442 bps for the hedge funds.

The estimate of a survivorship bias averaging 442 bps is considerably larger than those found by other investigators. Estimates of survivorship bias by Brown, Goetzmann, and Ibbotson (1999), Brown, Goetzmann, and Park (2001), Liang (2000, 2001), and Fung and Hsieh (1997) range from 60 bps to 360 bps a year for various hedge fund types. In a study covering data for a sample period similar to ours, Amin and Kat (2003) estimated survivorship bias at about 200 bps a year. In a study covering a period prior to ours, Ackerman, McEnally, and Ravenscraft (1999) found estimates of survivorship bias that were small and insignificant.

When we also estimated survivorship bias by hedge fund category, we found substantial differences between live and defunct funds in all categories. Interestingly, we also found substantial survivorship bias in the fund-of-funds category. This finding contradicts the claim of Lamm (2003) that survivorship bias in the fund-of-funds category is relatively small.

Table 4. Survivorship Bias in Mutual Fund Returns, 1996–2003

Year	Mean Return	Count	Mean Return	Count	Difference in Means	*t*-Statistic
A. Live vs. defunct funds						
	Live		Defunct			
1996	16.42%	2,328	13.32%	1,286	3.10 pps	10.32*
1997	18.09	3,123	11.03	1,520	7.05	14.12*
1998	11.41	3,691	4.77	1,705	6.64	13.32*
1999	33.01	4,173	32.08	1,709	0.93	0.90
2000	–2.28	4,944	–10.17	1,852	7.89	16.89*
2001	–11.26	5,965	–16.52	1,713	5.26	13.68*
2002	–19.46	7,006	–23.58	1,362	4.12	11.71*
2003	31.92	8,416	30.64	754	1.28	3.55*
Arithmetic mean	9.73%		5.20%		4.29 pps	10.38*
Geometric mean	8.19		3.37			
B. Live vs. live + defunct funds						
	Live		Live + Defunct			
1996	16.42%	2,328	15.32%	3,614	1.10 pps	
1997	18.09	3,132	15.78	4,643	2.31	
1998	11.41	3,691	9.31	5,396	2.10	
1999	33.01	4,173	32.74	5,882	0.27	
2000	–2.28	4,944	–4.43	6,796	2.15	
2001	–11.26	5,965	–12.43	7,678	1.17	
2002	–19.46	7,006	–20.13	8,368	0.67	
2003	31.92	8,416	31.81	9,170	0.11	
Arithmetic mean	9.73%		8.49%		1.23 pps	
Geometric mean	8.19		6.91			

Notes: The sample includes all general equity funds as reported by Lipper. A fund was categorized as live if it had reported returns as of December 2003.

*Significant at the 5 percent or better level of confidence.

Source: Data from Lipper.

We believe our estimates of survivorship bias tend to be higher than those of previous investigators for several reasons. First, other investigators used different datasets. For example, Liang (2001) stated that Hedge Fund Research (HFR), the database provider for some of the previous studies, collects less information on defunct funds than TASS collects. Liang found that his estimates of survivorship bias based on the HFR dataset were more than 160 bps lower than those found using the TASS database. Also, the dataset used by Brown, Goetzmann, and Ibbotson reports only annual returns and thus excludes data for funds that stopped reporting during the year. Even so, they found, on average, a difference of 300 bps between surviving funds and all funds, not too dissimilar to our own estimate. Another reason for the higher bias we found is that we used only contemporaneously reported data, rather than both contemporaneous and backfilled data, to estimate survivorship bias. In addition, we used a more recent period than other investigators have used, and our sample size was substantially larger. Finally, data on defunct funds are not easily obtainable from the data-gathering services, but we were particularly diligent in getting TASS to provide data on *all* hedge funds that stopped reporting during the period studied.

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 tested this hypothesis by analyzing whether winners tend to repeat their success in the subsequent year. We called a hedge fund manager who realized a return larger than the median hedge fund return for that year a "winner." A "loser" was a fund that realized a below-median return. For the

previous year's winners, we then asked whether these funds were winners (winners-to-winners) or losers (winners-to-losers) in the next year. **Table 5** presents the results. The year 1996 of Panel A illustrates our method. For 1995, we found 18 winners. Of them, about 61 percent (11) repeated winning performance in 1996, but about 39 percent (7) had below-median performance. Performing a *Z*-test for significance of repeat winning, we found that the difference was not significant. We found similar results for the entire 1996–2003 period. Indeed, the probability of observing repeat winners during the period was basically 50–50.

In the analysis reported in Panel A of Table 5, we assumed that any fund that stopped reporting was a loser, but because funds may cease reporting simply because they do not wish to attract new investments, Panel B reports results when we left funds out that were dropped from the database without considering them either winners or losers. We found somewhat more persistence (approximately 55 percent of winners repeated) in this case, but the results (and significance) vary considerably by year.[11]

Past studies have tended to find slightly more persistence than we report in Table 5. Agarwal and Naik (2000), examining data from HFR (which provides data on more than 1,000 living and dead hedge funds), measured a hedge fund's alpha as the return from the hedge fund minus the average return for all hedge funds following the same strategy. They performed parametric and nonparametric tests of quarterly performance persistence and found reasonable amounts of persistence from quarter to quarter for January 1994 through December 1998. The HFR database is known to have a lower attrition rate, however, and to include far fewer failed funds than other databases. Moreover, the authors stated that the persistence they found was driven mainly by losers persisting in losing rather than by winners repeating.[12]

The high attrition rates of hedge funds and lack of persistence in their returns underscore an aspect of risk that is not frequently mentioned. To be sure, hedge funds tend to have low standard deviations of returns and low betas. Thus, they can be excellent diversifiers and can produce alphas even if their returns are overestimated. But investors also need to be concerned about the cross-sectional distributions of returns (i.e., the risk of choosing a particularly poorly performing hedge fund). **Table 6** displays the cross-sectional standard deviations by hedge fund category for 1996–2003. Note that the cross-sectional standard deviation of hedge fund returns is considerably higher than it is for mutual funds. In other words, although the rewards from selecting the top-performing hedge funds are very high, so is the risk of selecting a dismal performer.

Table 5. Persistence in Hedge Fund Returns, 1996–2003

Year	Winner to Winner	Winner to Loser	Total	% Repeat Winner	*Z*-Test Repeat Winner
A. Dropped funds considered losers					
1996	11	7	18	61.11%	0.9
1997	82	66	148	55.41	1.3
1998	134	125	259	51.74	0.6
1999	145	200	345	42.03	–3.0
2000	172	227	399	43.11	–2.8
2001	276	199	475	58.11	3.5
2002	304	191	495	61.41	5.1
2003	312	476	788	39.59	–5.8
Average				51.56%	0.0
B. Dropped funds not considered in the analysis					
1996	11	5	16	68.75%	1.5
1997	70	54	124	56.45	1.4
1998	113	104	217	52.07	0.6
1999	124	140	264	46.97	–1.0
2000	142	181	323	43.96	–2.2
2001	226	150	376	60.11	3.9
2002	275	144	419	65.63	6.4
2003	298	380	678	43.95	–3.1
Average				54.74%	0.9

Notes: The *Z*-test determined the significance of the persistence against a χ^2 distribution of 50 percent. The winner-to-winner and winner-to-loser counts were based on medians derived from the universe of funds considered in each panel. Winner-to-winner counts differ in the panels because of independently calculated medians.

Probit Analysis of Probability of Fund Demise

Table 3 shows that a substantial proportion of the hedge funds in existence in the late 1990s failed to survive until April 2004. On average, well over 10 percent of all hedge funds stopped reporting to TASS.

The attrition rates each year are shown in **Table 7** and are compared with attrition rates for mutual funds. Most hedge fund attrition rates are three or four times greater than the mutual fund rates, and the differences are highly significant.

We undertook a probit regression analysis to examine the factors that contribute to the probability of a fund's demise. We theorized that the larger funds are more likely to survive and that poor performance is the reason funds drop from the database. In the probit analysis, the dependent

Table 6. Cross-Sectional Standard Deviations by Category, 1996–2003

Fund	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 market 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 equity 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

Notes: Returns for both live and defunct funds were used; returns were not backfilled. Each yearly figure represents the average of monthly cross-sectional standard deviations for each category. The final average figure is the average of all the yearly cross-sectional standard deviations.

variable was binary, taking a value of 1 if a fund was defunct ("exiting") and a value of 0 if it was still alive ("existing"). We used the following explanatory variables:

- The fund's return in each quarter for the most recent four quarters. For a nonsurviving fund, the most recent quarters are those prior to the period it stopped reporting to TASS. We expected that hedge funds would be more likely to stop reporting if they had produced low recent returns.
- The standard deviation of the fund's return for the most recent year. A higher variability of recent returns was expected to increase the probability of a fund's demise.
- The fund's most recent performance relative to all other funds in the same primary category, which was proxied by the number of times in the final three months that the fund's monthly return fell below the monthly median return of all hedge funds in the same category. Poor relative performance was expected to increase a fund's probability of demise.
- The fund's size (assets, in billions of dollars) in the most recent month. We expected that the larger the size of the fund, all else being equal, the more likely it was to survive.

Table 7. Hedge Fund Attrition vs. Mutual Fund Attrition, 1994–2003

	Hedge Fund Attrition			Mutual Fund Attrition			
Year	Existing	Exiting	Attrition	Existing	Exiting	Attrition	χ^2-Statistic
1994	22	3	13.64%	2,407	61	2.53%	10.47*
1995	52	14	26.92	3,037	152	5.00	48.30*
1996	331	67	20.24	3,614	139	3.85	164.70*
1997	555	69	12.43	4,643	188	4.05	74.13*
1998	751	137	18.24	5,396	281	5.21	176.74*
1999	913	149	16.32	5,882	319	5.42	146.32*
2000	1,030	211	20.49	6,796	521	7.67	173.36*
2001	1,119	201	17.96	7,678	597	7.78	122.88*
2002	1,747	246	14.08	8,368	663	7.92	67.01*
2003	2,065	295	14.29	9,170	754	8.22	73.20*

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

*Significant at the 5 percent or better level of confidence.

Sources: Data from Lipper and TASS.

The results of the probit analysis are presented in **Table 8**. The coefficient estimates suggest that a fund's recent performance is an important determinant of the fund's probability of demise, but the coefficient for returns relative to peers is statistically insignificant. The coefficient on "Standard deviation for final 12 months" is positive and highly significant; thus, higher volatility of return apparently increases the probability of a fund's demise. The coefficient on size ("Estimated assets") is negative and highly significant, indicating that the larger funds have a lower probability of exiting. Thus, the funds that stop reporting to TASS are likely to be the poor performers rather than funds that have become so large that they no longer wish to attract new investments.

Conclusion

Hedge funds are marketed as an "asset class" that provides generous returns during all stock market environments and thus serves as excellent diversification for an all-equity portfolio. The funds have attracted close to $1 trillion of investment capital.

We showed that the practice of voluntary reporting and the backfilling of only favorable past results can cause returns calculated from hedge fund databases to be biased upward. Moreover, the considerable attrition that characterizes the hedge fund industry results in substantial survivorship bias in the returns of indices composed of only currently existing funds.

Correcting for such biases, we found that hedge funds have returns lower than commonly supposed. Moreover, although the funds tend to exhibit low correlations with general equity indices—and, therefore, are excellent diversifiers—hedge funds are extremely risky along another dimension: The cross-sectional variation and the range of individual hedge fund returns are far greater than they are for traditional asset classes. Investors in hedge funds take on a substantial risk of selecting a dismally performing fund or, worse, a failing one.

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Table 8. Probit Regression
(explained variable: probability of fund demise)

Explanatory Variable	Coefficient	Standard Deviation	Z-Statistic
Q1	–1.47	0.36	–4.06*
Q2	–4.93	0.32	–15.54*
Q3	–2.74	0.33	–8.42*
Q4	–3.71	0.35	–10.72*
Standard deviation for final 12 months	17.76	0.92	19.32*
Peer comparison	0.00	0.03	–0.17
Estimated assets	–1.30	0.17	–7.76*
Constant	–0.37	0.07	–5.49*

Notes: Variables are as follows:
Q1 = return for the first quarter before the end of fund performance,
Q2 = return for the second quarter before the end of fund performance,
Q3 = return for the third quarter before the end of fund performance,
Q4 = return for the fourth quarter before the end of fund performance,
Standard deviation for final 12 months = standard deviation for the year prior to the end of fund performance,
Peer comparison = number of times in the final three months the fund's monthly return fell below the monthly median of all funds in the same primary category, and
Estimated assets = assets of the fund (in billions of dollars) estimated at the end of performance (if estimated assets were missing for the final month, the first available amount of estimated assets in the final four months was used).

Notes

1. Based on information from Van Hedge Fund Advisors International and authors' estimates.
2. All data reported in the tables are from TASS unless otherwise noted.
3. The category in which a hedge fund is placed in the TASS database (equity market neutral, event driven, etc.) is self-classified by the fund.
4. Lu and Mulvey (2001) found that hedge funds with positive skewness tend to have lower rates of return because they are the more desirable funds.
5. The Jarque–Bera statistic is used as a test of the joint hypothesis that skewness and kurtosis are, respectively, 0 and 3. The J–B test uses a χ^2 distribution with 2 degrees of freedom, and its statistic is given by $JB = n\{(S^2/6) + [(K-3)^2/24]\}$, where n denotes number of observations, S is the skewness coefficient, and K is the kurtosis coefficient. See Jarque and Bera (1987).
6. The analysis was carried out after 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. For example, 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.
7. There is a third bias that may be called "end-of-life bias." Hedge funds generally stop reporting poor results during the last months of their existence. Although data are not available to estimate this bias, we note that even our adjusted return data may be biased upward.
8. Data for 1994 and 1995 were excluded from the analysis because almost all of these data were backfilled rather than contemporaneously reported.
9. Another aspect of survivorship deserves mention—the effect of high-water marks. 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 will 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," and it explains a large amount of the 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 have an incentive to close the fund and open a new one on which any increase in asset value will earn an incentive fee. Brown, Goetzmann, and Park (2001) found another effect of the high-water mark—namely, 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 managers are apparently "rolling the dice" in an attempt to exceed the high-water mark. If they fail to do so, they tend to disband the fund.
10. The averages in Table 3 were calculated by equal weighting the returns of all funds because data on asset size were not available for all funds. We found a systematic relationship between a fund's decision to report assets and fund performance; non-asset-reporting funds tended to be underperformers.
11. We found little difference in persistence by category of fund. The event-driven category showed the most persistence (57 percent of winners repeated).
12. In addition, the alphas estimated for each fund were likely to be biased upwards. The tendency of some hedge funds to report "stale" or "managed" prices tends to bias hedge fund betas downward.

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