Conditions for Survival: changing risk and the performance of hedge fund managers and CTAs

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Abstract: We investigate whether hedge fund and commodity trading advisor [CTA] return variance is conditional upon performance in the first half of the year. Our results are consistent with the Brown, Harlow and Starks (1994) findings for mutual fund managers. We find that good performers in the first half of the year reduce the volatility of their portfolios, but not vice-versa. The result that manager "variance strategies" depend upon relative ranking not distance from the high water mark threshold is unexpected, because CTA manager compensation is based on this absolute benchmark, rather than relative to other funds or indices. We conjecture that the threat of disappearance is a significant one for hedge fund managers and CTAs. An analysis of performance preceding departure from the database shows an association between disappearance and underperformance. An analysis of the annual hazard rates shows that performers in the lowest decile face a serious threat of closure. We find evidence to support the fact that survivorship and backfilling are both serious concerns in the use of hedge fund and CTA data.

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I. Introduction

Hedge funds and commodity trading advisors [CTAs] are curiosities in the investment management industry. Unlike mutual funds and to a large extent, pension fund managers, they have contracts that specify a dramatically asymmetric reward. Hedge fund managers and commodity trading advisors are both compensated with contracts that pay a fixed percentage of assets and a fraction of returns above a benchmark of the treasury bill rate or zero. In addition, most of these contracts contain a "high water mark" provision that requires the manager to make up past deficits before earning the incentive portion of the fee. What affect does this asymmetric contract have upon their incentives to invest effort and take risks? Goetzmann, Ingersoll and Ross (1997), Griblatt and Titman (1989) and Carpenter (1997) all show analytically that the value of the manager's contract is increasing in portfolio variance due to the call-like feature of the "high water mark" contract. In fact, Carpenter (1997) identifies a strategy in the variance of the portfolio that depends upon the distance of the net asset value of the portfolio from the high water mark — out-of-the-money managers have a strong incentive to increase variance, while in the money managers lower risk. Starks (1987) explores the tradeoffs between symmetric and asymmetric manager contracts and finds that this incentive to increase risk makes the asymmetric reward less attractive than a symmetric reward as an investment management contract. Her theory, as with Carpenter (1997) has testable implications about the variance strategies of money managers with asymmetric contracts.

Brown Harlow and Starks (1995) [BHS] present fascinating evidence on mutual fund variance strategies, however they only are able to examine the behavior of managers compensated by fixed or at best symmetric compensation plans: mutual funds are precluded by law from asymmetric rewards. Hedge fund and CTA data allow us to do something they could not — namely examine the variance strategies of managers compensated asymmetrically. We use the BHS methodology to test for changes in fund variance conditional upon performance in the first half of the year. Our results are puzzling — despite major differences in the form of manager compensation, we find little difference between the behavior of hedge fund/CTA managers and mutual fund managers. We identify a significant reduction in variance conditional upon having performed well. Given the compensation arrangements, we would expect that poor performers who survive increase volatility to meet their high water mark. However, this does not appear to be the case in our database of hedge fund/CTA managers.

In order to see how the variance strategy interacts with the high water mark threshold, we explore whether manager strategies are conditional upon absolute versus relative performance cutoffs. While the high-water-mark contract is designed to induce behavior conditional upon absolute performance, in fact we find evidence that managers pay more attention to their performance relative to the rest of the industry, despite the popular perception that hedge fund managers are market neutral and care only about absolute performance. However, this result is consistent with the theory and empirical results in Massa (1997) who finds that relative ranking will tend to dominate as the basis for manager behavior.

Why don't hedge fund managers and CTAs behave like theory says they should? Some kind of severe penalty, such as termination, would seem necessary to justify our evidence on the variance-response function of hedge fund managers and CTAs to interim performance. Although there is little in the high water mark contract to explicitly penalize poorly performing managers there are great implicit costs to taking risks that might lead to termination. In Brown, Goetzmann and Ibbotson (1997) we find that about 20% of hedge funds disappear each year. In this paper, we find that this number is twice as high for the lowest decile performers. Thus, we conjecture that the threat of withdrawals may discipline the risk-taking of under-performers.

Our empirical analysis of a database of CTA returns that extend from 1977 and hedge fund returns that extend from 1983 also reveals empirical regularities in this and similar databases which may prove useful to future researchers. First, we find strong evidence, consistent with that reported in Park (1995), that both CTA and hedge fund s may be brought into the database with a history of returns. This is imparts a potentially serious upward bias in performance studies. We apply Park's (1995) switching regression technology to identify the average number of months at the beginning of a fund history that appear to be biased in this manner. We find it reasonable to discard 27 months of fund performance at the beginning of its record to eliminate selection effects on aggregate measures of performance.[1]

The question of survival conditioning is potentially important to cross-sectional performance studies. We examine the factors associated with funds "exiting" our database, and find that these are closely tied to relative performance. Exiting funds tend to underperform by about 1% per month in the year proceding exit. The hazard rates for low decile performers are high: 20% to 40%, depending upon the year. Our survival analysis lends strong support to the conjecture that CTAs and hedge fund managers are seriously concerned with closure, as opposed to maximizing the option-like feature of their contract.

Brown, Goetzmann, Ibbotson and Ross (1992) point out that survivorship can induce spurious persistence in relative fund returns. Hendricks, Patel and Zeckhauser (1997) discover that

[1] Interestingly, using an alternative source for CTS returns (Managed Accounts Report), Park (1995) finds exactly the same cutoff period obtains.

survival induces a “J-shape” in performance and variance conditional upon past returns, while Carhart (1997) and Carpenter and Lynch (1997) show how multi-period survival conditioning induces contrasting patterns in persistence tests. Our analysis of the CTA and hedge fund returns is consistent with the Hendricks, Patel and Zeckhauser (1997) simulations indicating that the data we use is subject to attrition. Not only do we find that exiting managers tend to do so because of poor performance, we find patterns that indicate that this regularity manifests itself in biases in persistence studies using this data. How this attrition affects various other statistical tests about hedge fund and CTA return is a question to be addressed by researchers in the field.

This paper is structured as follows. The next section discusses the data. Section 3 reports the results of our empirical analysis, section 4 considers the causes of fund attrition in detail and section 5 concludes.

II. The TASS data

Tass is a New York-based advisory and information service that maintains a large database of CTA and hedge fund managers which they made available to us for analysis. Among the hedge fund managers are a number of fund-of-funds which allocate investments to different hedge funds for a fee. The Tass data is used in recent research by Hsieh and Fung (1997a&b). A competitor to Tass, Managed Account Reports (MAR) has data on both manager populations as well, and this is the data used by Ackerman, McEnally and Ravenscraft (1997) and Park (1995). Neither of these two sources is a “follow-forward” database, as is the data used in BGI. That is, we cannot verify the extent to which defunct funds have been dropped from the sample. TASS has recognized the importance of maintaining defunct funds in their data, and since 1994 they have kept records of hedge funds that cease to operate. A comparison to the annual "follow-forward" database of BGI suggests that the Tass hedge fund data under-represents the attrition rate observed over longer intervals.

Survival is not the only potential conditioning in the data. Park's (1995) analysis of the MAR data suggests that funds are typically brought into the database with a history. A switching regression method proves a useful tool for throwing out the early, misleading fund returns. We find evidence in the Tass data as well for "instant histories" and we apply the same technology for trimming funds of their early months.[2] This conditioning has two separate implications. First, a fund might be brought in because the manager has chosen to report a good track record -- i.e. self-selection bias. Second, a survival bias is imparted because having a two-year or more track record implies that the fund survived for two years, while others like it failed. Table I reports the time-series counts of CTAs and hedge funds. Notice that survival is an important issue for TASS' CTAs — roughly 20% disappear per year since 1990. It is important to note that this clearly understates the true attrition rate. Presumably funds that start and end intra-year would not be included in the database and the fact that we have evidence for funds being brought into the database with histories is strong evidence for self-selection by managers. The 20% attrition rate for CTAs is consistent with the numbers in BGI for offshore hedge funds. The attrition rates for the Tass hedge funds are

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[2] Following Park (1995) we specify a Chow test for structural change in the median monthly fund return series, where funds are alligned in event time, with the event being the first month of listing in the Tass database. Brown, Goetzmann and Ross (1995) show that under the null hypothesis of no performance threshold condition for inclusion in the database and no change of manager strategy, there should be no difference in the mean return through time. These results generalize to median returns as well. The median is used because of the extreme right-skew of the monthly distributions. We can reject equality of medians for all months before 27, suggesting that more than two years should be eliminated from consideration when using the data for performance evaluation.

suspiciously lower — less than 15% per year since 1994. As with the CTAs our test for a structural change indicates that at least 15 months of returns appears to be biased by selection and or survival.[3]

Table II reports summary statistics. Notice the dramatic effect of survival conditioning. Over the period 1983 through 1988, CTA returns were nearly 31% per year, while in the two four year periods since then they have been 18.6% and 9.1% respectively. These differences in mean returns suggest that the database may have been constructed by backfilling histories conditional upon existence in 1985 or later. The hedge fund database described in Table III manifests the same pattern. Notice that, in Table III, Pre-1989 returns are 20.7% per year. The two four year periods since then return 16.3% and 12.6% respectively. Table IV breaks out funds-of-funds separately. For these managers, the discrepency between the pre-1988 and the post-1988 periods is even more pronounced. Given this evidence for back-filling, even elimination of the early part of fund histories will not eliminate the bias. While we interpret this diminution of returns through time as evidence of selection bias, an alternative hypothesis is that returns for these two asset classes have be decreasing as the number of managers and amount of money under management in the industry has been increasing. The BGI annual database provides support against this alternative: returns since 1989 show no discernable downward trend.

Given the recent evidence regarding the biasing effects of both single-period and multi-period conditioning in explored in Carhart (1997) and Carpenter and Lynch (1997) Hendricks, Patel and Zeckhuaser (1997), it seems likely that the statistical analysis of both of these databases is likely

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[3] In BGI, we avoided the problem of "instant histories" by throwing out the fund returns before the first year of their listing in a published year book, *The Offshore Funds Directory*. We did not have to. Typically, the first year a fund was listed in the directory, it had one or more years of returns history.

to be biased. Fortunately, the direction of at least some of these biases are well understood as we show in the next section. For all the test of strategic variance choice in the next section, we apply the cutoff to disgard biased early fund histories.

III. Survival Strategies

III.1 Sorts by Deciles

Following BHS, we test whether fund performance in one period explains the change in variance of fund returns in the following period. Figures 1 and 2 show the simplest form of this test for CTAs and hedge funds. The figures plot the median fund standard deviation for the first half of the year by January to June performance decile, vs. The median fund standard deviation for the second half of the year by January to June performance deciles. "U" shape is to be expected: extreme performers are generally high-volatility funds. Notice that, for both hedge funds and CTAs the volatility of the top decile managers decreases in the second half of the year. For CTAs this is true for the top three deciles.

It is somewhat surprising to find that poor performers do not increase their variance. Given that the high water mark contract is effectively like a call option, one would expect a manager to rationally increase the value of this option, once it is out of the money, by increasing variance. Indeed, this is the classic moral hazard problem induced by asymmetric incentives. Either the managers behave morally, or the threat of investor withdrawal offsets the increase in the value of the contract due to raising variance. Threat of dismissal or fund closure cannot entirely protect against increase in variance, however. Given that 20% of CTA managers disappear each year since 1990, any fund in the lowest decile may have a relatively high probability of disappearance. Any manager who judges his or her likelihood of disappearance at mid year as a virtual certainty has a powerful incentive to "double down" by taking much higher risks. It is tempting to conjecture that conditioning upon survival over several periods would eliminate funds with really bad returns from the sample, but evidence on this awaits an analysis of the conditions under which funds exited the database.

III.2 Rank Correlation Tests

Table V tests the significance of the strategic use of variance by CTAs. It reports a Spearman rank correlation test for CTAs for all years, for four-year sub-periods and on a year-by-year basis. We show results by breaking the year into a four month evaluation period, followed by an eight month period, a five month evaluation period, followed by a seven month period, two six month periods, a seven month evaluation period an eight month period and so on. We provide these for ease of comparison to the BHS results.   The six month periods are the most natural temporal divisions, since this corresponds to halving the annual reporting period. The Spearman rank correlation allows us to test whether the effect varies with the magnitude of relative performance, while still controlling for the fact that CTA returns are highly non-normal in cross section. The results are strong across the whole period and the four-year sub-periods. Top performers drop their volatility in the second half of the year.   This same pattern is evident in the hedge fund unverse as well. Table VI reports the Spearman test for hedge fund managers. Over the whole time period, the shift in variance is significant at greater than a 95% confidence level.

Is this pattern induced by survival? Simulations approximating these strategic variance tests are reported in Brown, Goetzmann, Ibbotson and Ross (1997). We show that a 10% performance cut on the first period, corresponding to the elimination of the worst decile of performers would induce a "U" shape response of variance to returns. To the extent that the strategic variance effect is a reduction of variance by winners, the simulations in the BGIR 97 article would bias the test towards type II error. Thus, we do not believe the results are due to conditioning upon survival over the year-long period[4].

III.3 High Water Mark Thresholds

The high water mark contract used by CTAs and hedge fund managers essentially has a strike price which is reset upwards whenever the fund has a positive return for the year above the previous high. If a fund has a negative return, the manager is out of the money and presumably has an incentive to increase risk. What is important to the manager's decision to change the fund variance? Is it the distance of the fund value from the high water mark, or is it the rank of the fund relative to others? In the BHS setting, relative ranking was a natural benchmark, since net fund flows have been shown to depend upon ranking and it is the flow response that effectively makes the contract non-linear. With CTAs and hedge funds, the non-linearity in the compensation is explicit. Thus, we can test whether variance reduction is an explicit gaming of the incentive contract as Carpenter (1997) suggests.

We use a Wilcoxon test to examine whether the ratio of second half variance to first half variance is related to whether returns are above or below zero in the first half of the year. These results are reported in Table VII for CTAs and in Table VIII for hedge funds. Remarkably, the

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[4]Since we use the same six month return interval to compute initial period performance deciles and volatility, we share with BHS the problem that it is difficult to distinguish empirically risk-taking behavior from an unusually favorable outcome in the initial sample period. One possible resolution of this problem is to measure initial period return and volatility using alternate months of data.

strategic variance result disappears for the 12 month horizon. Evidently, performance relative to other funds is important, while performance relative to the high water mark is not.

IV. Attrition and Relative Performance

How great is the threat of fund closure, conditional upon poor performance relative to other managers? Table Shows the 24 month mean and median returns for CTAs and hedge fund managers before disappearance from the database. The return of an equal-weighted portfolio of fund managers has been subtracted to calculate relative returns. Also, we do not require a fund to exist for 24 months before disappearance to be included. While funds may exit the database for other reasons besides under-performance, the evidence in Table IX indicates that closure due to poor performance is the most common reason. Median relative returns for exiting CTAs are about -92 basis points per month in the preceding year and about 101 basis points per year for hedge funds. While not reported in the table, the same pattern is not evident for absolute performance. Exiting funds do not necessarily have a consistent history of negative returns before closure.

Table X reports the hazard rates estimated for both CTAs and hedge funds over the years for which the databases contain information about exiting funds. For CTAs there is a ten year history of fund exits. We calculate a running nine month return for each CTA, and then sort these each year into performance deciles, with 0 being the lowest decile of performance. Three things stand out from the panel on CTA hazard rates. First, the probability of exiting the database in the specified year is decreasing dramatically in the previous year's ranking. In some years, a lowest decile ranking is means a high probability of exit. Since 1992, this has been between 32% and 46%.

Another curious feature of the CTA hazard rate panel is that the years before 1992 are clearly different. Note that before 1992, extreme positive as well as extreme negative performance is associated with a high probability of exit. This is consistent with high variance leading to exit. While this pattern does not completely disappear after 1992, it is lessened. Evidently there are exit risks associated with a strategy of increasing variance. Finally, note that the relationship between performance and hazard rates is inverse for most years but not all. In particular, 1991 shows a reversal. This suggestive on a style effect — one set of strong performers in 1990 turned out to have done very poorly in 1991 and exited the database.

In the second panel of Table X, we report hazard rates conditional upon performance for hedge funds.   Since we only have three years of data on hedge fund managers that include defunct funds, the results cannot be examined over many different market periods. Although 1994 was a poor one for hedge funds, the inverse relationship is still partly evident. On average, across the three years, the probability of exiting the database conditional upon being in the lowest decile is over 20%.

In sum, the hazard rate analysis confirms the conjecture that CTA and hedge fund managers face a high probability of "exiting" when the underperform relative to other funds in the industry. There is at least some evidence from the CTA data that the probability of exit is related to fund variance as well as performance. This pattern in important, since the puzzle about managers compensated asymmetrically is why they do not increase the variance of assets when they perform poorly. The answer appears to be that the potential costs of such a strategy due to closure outweigh the benefits.

V. Conclusion

Despite the fact that we find strong evidence of the BHS strategic variance effect on a very different sector of the money management industry, the results remain a puzzle. While they fit with certain conjectures derived from theory about investment manager compensation, they appear to contradict others. In our analysis we find some unexpected results. First, we find little evidence of "doubling down" by extreme losers, despite the high expectation that lowest decile funds would disappear next period. In addition, while high water mark contracts have explicit thresholds below which managers fail to earn fat incentive fees, we see no evidence that they increase the probability of exceeding the threshold when they are out of the money.

Our analysis of the TASS database reveals some interesting things about fund attrition and conditions under which data in the CTA and hedge fund industry is collected. Analysts concerned with single-period and multi-period conditioning biases will have both to worry. While this has relatively little influence on the analysis of styles, as in Hsieh and Fung (1997) it can be misleading to studies of performance persistence and risk-adjusted returns to the industry as a whole.

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Table 1: TASS Database of CTAs and Funds								
	CTAs				Hedge Funds			
	Total Funds	New Funds	Bankrupt Funds	Surviving Funds	Total Funds	New Funds	Bankrupt Funds	Surviving Funds
1971	1	1	0	1				
1972	1	0	0	1				
1973	2	1	0	2				
1974	3	1	0	3				
1975	4	1	0	4				
1976	6	2	0	6				
1977	7	1	0	7	2	2	0	2
1978	8	1	0	8	4	2	0	4
1979	13	5	0	13	5	1	0	5
1980	20	7	0	20	6	1	0	6
1981	29	9	0	29	8	2	0	8
1982	37	8	0	37	12	4	0	12
1983	50	13	0	50	19	7	0	19
1984	77	27	0	77	28	9	0	28
1985	107	30	0	107	35	7	0	35
1986	142	35	1	141	53	18	0	53
1987	189	47	3	185	82	29	0	82
1988	254	65	5	245	109	27	0	109
1989	346	92	13	324	143	34	0	143
1990	431	85	51	358	227	84	0	227
1991	555	124	64	418	316	89	0	316
1992	688	133	72	479	449	133	0	449
1993	787	99	96	482	662	213	0	662
1994	864	77	116	443	863	201	31	832
1995	920	56	113	386	1060	197	75	954
1996	948	28	97	317	1230	170	138	986

Table 2: CTAs: Returns and Standard Deviations

Year	Number of CTAs	Randomly Selected CTA: Monthly Return	Randomly Selected CTA: Annual Return	Randomly Selected CTA: Standard Deviation	Equal-Weighted Market Portfolio of CTAs: Monthly Return	Equal-Weighted Market Portfolio of CTAs: Annual Return	Equal-Weighted Market Portfolio of CTAs: Standard Deviation	NAV-Weighted Market Portfolio of CTAs: Monthly Return	NAV-Weighted Market Portfolio of CTAs: Annual Return	NAV-Weighted Market Portfolio of CTAs: Standard Deviation
		- percent -			- percent -			- percent -		
1983	26	1.771	23.452	11.196	1.904	25.405	8.548	2.097	28.285	8.883
1984	36	1.288	16.603	11.537	1.431	18.593	8.167	1.414	18.348	7.982
1985	48	2.322	31.712	10.886	2.526	34.893	5.496	2.543	35.168	5.462
1986	72	0.814	10.212	10.867	1.336	17.268	6.018	1.246	16.023	6.115
1987	101	3.175	45.513	12.359	4.095	61.876	7.095	3.841	57.184	7.055
1988	135	2.058	27.698	13.863	2.418	33.200	9.420	2.274	30.970	8.713
1989	164	1.174	15.038	10.878	0.951	12.026	5.287	1.225	15.736	6.416
1990	218	2.866	40.360	8.106	2.627	36.504	3.628	3.281	47.312	4.956
1991	262	0.577	7.153	7.648	0.690	8.602	4.293	0.615	7.630	4.052
1992	287	0.292	3.561	5.973	0.332	4.062	3.139	0.296	3.614	2.985
1993	329	0.787	9.867	5.201	0.949	11.996	2.420	0.973	12.317	2.541
1994	381	-0.011	-0.128	5.302	-0.021	-0.254	2.367	-0.022	-0.264	2.356
1995	366	0.923	11.658	5.331	1.080	13.764	2.534	1.109	14.152	2.540
1996	336	0.647	8.051	5.334	0.876	11.027	3.119	0.821	10.310	3.116
Average:										
1983-96		1.335	17.911	8.892	1.514	20.640	5.109	1.551	21.199	5.227
1983-88		1.905	25.865	11.785	2.285	31.872	7.457	2.236	30.996	7.368
1989-92		1.227	16.528	8.151	1.150	15.298	4.087	1.354	18.573	4.602
1993-96		0.587	7.362	5.292	0.721	9.133	2.610	0.720	9.129	2.638

Notes: Monthly Return: the twelfth root of the annual return. Annual Return: the monthly compounded annual return. Randomly Selected: We compute the statistic for the year for each trader, then average across all traders. Equal-Weighted Market Portfolio: We average across all traders to get portfolio returns for each month. Then we produce the yearly statistic from the monthly returns. (Horizon is one month.) NAV-Weighted Market Portfolio: The method is the same as above, except that the average across all traders for a month is weighted. A trader's weight is proportional to his net asset value during this month, under the assumption that each trader begins each year with equal assets, which grow as its monthly returns. If one considers the market portfolio as the returns of one dollar split equally among every available trader, then the capital of a trader who goesbankrupt during the year is redistributed to the remaining traders pro rata. Similarly, traders who start during a year receive the current average assets, which are raised by pro rata distributions from every other trader. (Horizon is one year.) Average: The arithmetic average of this statistic across all the years in the period.

Table 3: Hedge Funds with Cutoff: Returns and Standard Deviations

		Randomly Selected Fund			Equal-Weighted Market Portfolio of Funds			NAV-Weighted Market Portfolio of Funds		
Year	Number of Funds	Monthly Return	Annual Return	Standard Deviation	Monthly Return	Annual Return	Standard Deviation	Monthly Return	Annual Return	Standard Deviation
		- percent -			- percent -			- percent -		
1983	9	0.96	12.10	12.90	2.30	31.37	9.33	1.28	16.54	9.65
1984	15	0.85	10.67	10.53	1.23	15.76	7.55	0.90	11.35	7.00
1985	24	2.41	33.10	6.17	2.62	36.44	3.69	2.72	37.99	3.71
1986	30	0.74	9.30	6.84	0.97	12.27	4.33	0.95	12.04	4.47
1987	44	1.64	21.60	9.37	2.23	30.30	4.94	2.07	27.87	5.35
1988	70	1.22	15.72	6.28	1.48	19.24	4.44	1.41	18.35	4.12
1989	88	0.89	11.27	5.64	1.07	13.69	3.61	1.02	12.92	3.51
1990	119	1.43	18.54	4.83	1.60	21.04	1.61	1.64	21.50	1.83
1991	179	1.30	16.83	5.82	1.51	19.72	2.84	1.50	19.63	2.60
1992	245	0.81	10.23	4.71	0.91	11.52	1.56	0.89	11.21	1.38
1993	352	1.56	20.47	4.19	1.74	23.02	1.46	1.79	23.75	1.58
1994	540	-0.11	-1.34	4.11	-0.16	-1.96	0.99	-0.16	-1.91	0.99
1995	669	0.98	12.46	4.14	1.09	13.92	1.22	1.13	14.49	1.22
1996	761	0.96	12.14	4.23	1.08	13.77	1.72	1.11	14.14	1.78
Average:										
1983-96		1.12	14.51	6.41	1.41	18.58	3.52	1.30	17.13	3.51
1983-88		1.30	17.08	8.68	1.80	24.23	5.71	1.56	20.69	5.72
1989-92		1.11	14.22	5.25	1.28	16.49	2.40	1.26	16.31	2.33
1993-96		0.85	10.93	4.17	0.94	12.19	1.35	0.97	12.62	1.39

Notes: Monthly Return: the twelfth root of the annual return. Annual Return: the monthly compounded annual return. Randomly Selected: We compute the statistic for the year for each trader, then average across all traders. Equal-Weighted Market Portfolio: We average across all traders to get portfolio returns for each month. Then we produce the yearly statistic from the monthly returns. (Horizon is one month.) NAV-Weighted Market Portfolio: The method is the same as above, except that the average across all traders for a month is weighted. A trader's weight is proportional to his net asset value during this month, under the assumption that each trader begins each year with equal assets, which grow as its monthly returns. If one considers the market portfolio as the returns of one dollar split equally among every available trader, then the capital of a trader who goesbankrupt during the year is redistributed to the remaining traders pro rata. Similarly, traders who start during a year receive the current average assets, which are raised by pro rata distributions from every other trader.(Horizon is one year.) Average: The arithmetic average of this statistic across all the years in the period.

Table 4: Funds of Funds with Cutoff: Returns and Standard Deviations

Year	Number of Funds	Randomly Selected Fund			Equal-Weighted Market Portfolio of Funds			NAV-Weighted Market Portfolio of Funds		
		Monthly Return	Annual Return	Standard Deviation	Monthly Return	Annual Return	Standard Deviation	Monthly Return	Annual Return	Standard Deviation
		- percent -			- percent -			- percent -		
1983	1	1.70	22.47	3.03	1.70	22.47	3.03	1.70	22.47	3.03
1984	2	0.15	1.78	4.09	-0.12	-1.43	3.87	-0.13	-1.49	3.88
1985	3	3.15	45.02	5.82	3.62	53.28	4.66	3.65	53.68	4.68
1986	3	0.95	11.97	8.65	1.11	14.16	5.70	0.95	11.97	5.61
1987	4	2.35	32.16	7.24	2.52	34.77	4.78	2.71	37.79	4.57
1988	9	0.22	2.68	5.16	0.18	2.18	3.66	0.34	4.21	3.61
1989	11	1.40	18.15	5.28	1.61	21.12	3.73	1.59	20.85	3.90
1990	19	1.26	16.27	3.73	1.43	18.57	0.95	1.44	18.70	1.02
1991	34	0.47	5.84	3.10	0.52	6.42	1.35	0.53	6.56	1.35
1992	42	0.47	5.80	2.97	0.53	6.49	0.78	0.51	6.23	0.70
1993	63	1.59	20.86	2.75	1.86	24.75	1.59	1.93	25.77	1.62
1994	81	-0.27	-3.21	2.86	-0.34	-4.04	1.26	-0.32	-3.78	1.30
1995	105	0.59	7.29	2.62	0.59	7.32	1.37	0.62	7.70	1.37
1996	140	0.89	11.28	3.00	1.00	12.71	1.83	0.98	12.41	1.85
Average:										
1983-96		1.07	14.17	4.31	1.16	15.63	2.75	1.18	15.93	2.75
1983-88		1.42	19.35	5.67	1.50	20.90	4.28	1.54	21.44	4.23
1989-92		0.90	11.52	3.77	1.02	13.15	1.70	1.02	13.09	1.74
1993-96		0.70	9.06	2.81	0.78	10.18	1.51	0.80	10.52	1.53

Notes: Monthly Return: the twelfth root of the annual return. Annual Return: the monthly compounded annual return. Randomly Selected: We compute the statistic for the year for each trader, then average across all traders. Equal-Weighted Market Portfolio: We average across all traders to get portfolio returns for each month. Then we produce the yearly statistic from the monthly returns. (Horizon is one month.) NAV-Weighted Market Portfolio: The method is the same as above, except that the average across all traders for a month is weighted. A trader's weight is proportional to his net asset value during this month, under the assumption that each trader begins each year with equal assets, which grow as its monthly returns. If one considers the market portfolio as the returns of one dollar split equally among every available trader, then the capital of a trader who goesbankrupt during the year is redistributed to the remaining traders pro rata. Similarly, traders who start during a year receive the current average assets, which are raised by pro rata distributions from every other trader.(Horizon is one year.) Average: The arithmetic average of this statistic across all the years in the period.

Table 5: CTA Tournaments with Cutoff
Spearman Rank Test

Assessment:	(4,4)		(5,5)		(6,6)		(7,7)		(8,8)	
Timespan	p-values									
1983-1996	0.0001	**	0.0001	**	0.0001	**	0.0001	**	0.0001	**
1983-1988	0.0177	*	0.0443	*	0.0004	**	0.0234	*	0.0664	
1989-1992	0.0002	**	0.0001	**	0.0004	**	0.0006	**	0.0001	**
1993-1996	0.0001	**	0.0001	**	0.0180	*	0.0072	**	0.0003	**
1983	(0.0844)		(0.5480)		(0.8949)		(0.7720)		(0.7672)	
1984	0.8870		(0.7600)		0.7715		(0.0218)	o	(0.0072)	oo
1985	(0.4088)		(0.5466)		0.7994		0.1103		0.0131	*
1986	0.0885		0.3437		0.2638		0.7812		(0.3725)	
1987	0.0154	*	0.0383	*	0.0579		0.0856		0.0503	
1988	0.0311	*	0.0480	*	0.0001	**	0.0066	**	0.0247	*
1989	0.0624		0.0031	**	0.4116		(0.9365)		(0.9204)	
1990	0.1079		0.0001	**	0.0001	**	0.0067	**	0.0634	
1991	0.0158	*	0.1071		0.0780		0.0056	**	0.0015	**
1992	0.1132		0.0052	**	0.4563		0.1776		0.0040	**
1993	0.1931		0.6987		(0.4575)		(0.8454)		0.9320	
1994	0.1942		0.0086	**	0.0998		0.0320	*	0.0704	
1995	0.0001	**	0.0001	**	0.0008	**	0.0071	**	0.0001	**
1996	0.1069		0.6264		0.6881		0.4986		0.9260	

P-values for aggregate periods were computed directly.
P-values in parentheses indicate results contrary to the expected alternative.
A ** indicates a result significant at 99% level, and * indicates 95% significance.
A oo indicates a result significant at 99% level, and o indicates 95% significance, in the opposite sense.

Table 6: Fund Tournaments with Cutoff
Spearman Rank Test

Assessment:	(4,4)		(5,5)		(6,6)		(7,7)		(8,8)	
Timespan	p-values									
1983-1996	0.0001	**	0.0001	**	0.0001	**	0.0001	**	0.0001	**
1983-1988	0.0301	*	0.0571		0.0925		0.1704		0.0262	*
1989-1992	0.0001	**	0.0001	**	0.0009	**	0.0001	**	0.0002	**
1993-1996	0.0059	**	0.2038		0.0008	**	0.0001	**	0.0001	**
1983	(0.0710)		(0.0208)	o	(0.0208)	o	(0.0149)		0.0856	
1984	0.8317		0.8110		0.8944		0.8944		(0.1025)	
1985	0.8548		(0.8933)		0.9514		(0.874)		(0.4941)	
1986	0.2392		(0.7393)		0.8751		0.1989		0.1745	
1987	0.2208		0.0953		0.3793		0.6055		0.6421	
1988	0.0109	*	0.0014	**	0.0038	**	0.0560		0.0024	**
1989	0.0001	**	0.0011	**	0.0656		0.0073	**	0.0425	*
1990	0.0095	**	0.9296		(0.8975)		0.3263		0.8041	
1991	0.0114	*	0.1127		0.0010	**	0.0002	**	0.0002	**
1992	0.0001	**	0.0001	**	0.1265		0.0671		0.1181	
1993	0.1326		0.9575		0.7130		0.6474		(0.1787)	
1994	(0.541)		(0.0162)	o	0.6320		(0.8775)		0.3632	
1995	0.0211	*	0.0045	**	0.1354		0.0044	**	0.0005	**
1996	0.0385	*	0.1563		0.0002	**	0.0001	**	0.0001	**

P-values for aggregate periods were computed directly.
P-values in parentheses indicate results contrary to the expected alternative.
A ** indicates a result significant at 99% level, and * indicates 95% significance.
A oo indicates a result significant at 99% level, and o indicates 95% significance, in the opposite sense.

Table 7: CTA versus Zero
Wilcoxon Test with Cutoff

Assessment:	(4,4)		(5,5)		(6,6)		(7,7)		(8,8)	
Timespan	p-values									
1983-1996	2.2E-04	**	8.5E-06	**	0.004	**	0.012	*	0.028	*
1983-1988	0.324		0.392		0.199		0.754		(0.300)	
1989-1992	0.039	*	2.8E-06	**	0.004	**	0.008	**	0.003	**
1993-1996	2.7E-04	**	0.009	**	0.334		0.091		0.016	*
1983	(0.232)		(0.163)		1.000		0.649		(0.887)	
1984	(0.786)		0.903		0.269		(0.657)		(0.011)	
1985	(0.531)		(0.469)		(0.485)		(0.744)		0.497	
1986	0.839		0.480		0.470		(0.991)		(0.028)	
1987	0.386		0.526		0.642		(0.834)		1.000	
1988	0.001	**	0.006	**	0.121		0.192		0.096	
1989	0.441		0.050		0.636		(0.432)		(0.617)	
1990	0.184		5.3E-04	**	0.001	**	0.007	**	0.072	
1991	0.180		0.163		0.159		0.050	*	0.048	*
1992	0.496		0.011	*	0.505		0.165		0.007	**
1993	0.484		0.697		(0.954)		(0.775)		0.961	
1994	0.088		0.013	*	0.130		0.161		0.144	
1995	5.1E-05	**	0.016	*	0.244		0.135		7.1E-04	**
1996	0.408		(0.929)		(0.490)		0.442		(0.921)	

Yearly p-values are from a Wilcoxon test of ranked risk-adjustment ratio for groups with interim performance above 0 and below 0. P-values are 2-sided. P-values in parentheses indicate results contrary to the expected alternative.
A ** indicates a result significant at 99% level, and * indicates 95% significance.

Table 8: Fund versus Zero
Wilcoxon Test with Cutoff

Assessment:	(4,4)		(5,5)		(6,6)		(7,7)		(8,8)	
Timespan	p-values									
1983-1996	0.001	**	(0.832)		0.500		0.018	*	0.001	**
1983-1988	0.078		(0.913)		(0.431)		(0.464)		(0.186)	
1989-1992	9.6E-05	**	0.086		0.054		0.006	**	0.001	**
1993-1996	0.901		(0.048)	o	0.767		0.009	**	1.4E-04	**
1983	(0.470)		(0.233)		(0.074)		(0.030)	o		
1984	0.927		(0.777)		(0.475)		(0.927)		(0.019)	o
1985	(0.815)		(0.168)		0.928		0.623		(0.182)	
1986	0.037	*	1.000		0.977		0.908			
1987			(0.683)		(0.671)		(0.761)		(0.544)	
1988	0.006	**	0.003	**	0.378		0.875		0.101	
1989	0.025	*	(0.727)		0.467		0.028	*	0.125	
1990	(0.471)		(0.663)		0.817		(0.955)		0.232	
1991	0.045	*	(0.726)		0.018	*	2.4E-04	**	7.7E-05	**
1992	1.9E-05	**	4.9E-06	**	0.592		(0.717)		(0.880)	
1993	0.948		(0.464)		0.894		0.555		0.834	
1994	(0.352)		(0.006)	oo	0.810		(0.541)		0.895	
1995	(0.307)		(0.805)		(0.446)		0.072		0.017	*
1996	0.033	*	(0.819)		0.327		0.001	**	1.1E-06	**

Yearly p-values are from a Wilcoxon test of ranked risk-adjustment ratio for groups with interim performance above 0 and below 0. P-values are 2-sided. P-values in parentheses indicate results contrary to the expected alternative. A ** indicates a result significant at 99% level, and * indicates 95% significance.

Table 9: Market Underperformance vs. Time Until Exit

CTAs				Hedge Funds			
Months Left	Median Return	Mean Return	Standard Deviation	Months Left	Median Return	Mean Return	Standard Deviation
0	-1.24	-1.23	9.26	0	-0.92	-1.08	5.71
1	-1.09	-0.07	18.38	1	-0.64	-0.69	4.66
2	-1.25	-0.68	12.57	2	-1.11	-0.54	4.88
3	-0.60	-0.93	9.01	3	-1.33	-1.45	4.61
4	-1.40	-1.53	7.90	4	-1.00	-1.38	4.65
5	-1.32	-1.14	7.72	5	-1.12	-1.83	5.12
6	-0.54	-0.61	10.26	6	-1.14	-1.53	6.62
7	-0.54	0.33	11.27	7	-1.13	-1.27	6.36
8	-1.02	-1.49	7.26	8	-0.79	-0.98	4.54
9	-0.65	0.82	24.66	9	-0.78	-1.33	6.32
10	-0.21	0.12	8.18	10	-0.56	-0.57	4.70
11	-0.72	-0.88	8.32	11	-0.53	-0.33	4.70
12	-0.55	-0.11	9.48	12	-1.06	-0.94	4.84
13	-0.66	-0.84	7.74	13	0.17	-0.02	5.26
14	-0.49	-0.40	8.79	14	-0.31	-0.22	4.86
15	-0.31	-0.79	8.74	15	-0.59	-0.61	4.28
16	-0.47	-0.74	6.30	16	-0.28	-0.97	6.29
17	-1.15	-0.38	10.16	17	-0.99	-1.07	4.86
18	-0.51	0.38	11.82	18	-0.42	-0.11	4.70
19	-1.23	-0.55	8.98	19	-0.63	-0.73	4.90
20	-0.23	-0.17	10.01	20	-0.29	-0.61	5.56
21	-0.47	-1.16	6.25	21	-0.25	-0.64	4.51
22	0.41	1.04	12.51	22	-0.57	-0.09	4.06
23	-0.89	-0.27	7.98	23	0.18	-0.08	3.99
24	-0.77	-1.09	8.44	24	0.27	0.20	6.35

The return of an equal-weighted market portfolio in the same calendar month has been subtracted from each individual return. Returns are expressed in percent per month.

The standard deviation is among the returns for all individuals with the same amount of time

Table 10: Hazard Rates by Performance

CTAs (n = 9 months)

Year	Decile 0	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9
87	0.11	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.10
88	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
89	0.06	0.00	0.19	0.08	0.00	0.07	0.06	0.00	0.00	0.00
90	0.19	0.16	0.10	0.36	0.25	0.11	0.05	0.05	0.00	0.11
91	0.09	0.21	0.18	0.18	0.10	0.18	0.18	0.14	0.09	0.25
92	0.45	0.16	0.08	0.12	0.23	0.08	0.09	0.13	0.00	0.09
93	0.32	0.18	0.30	0.21	0.12	0.18	0.11	0.15	0.00	0.08
94	0.46	0.38	0.30	0.25	0.22	0.20	0.13	0.10	0.16	0.03
95	0.43	0.31	0.33	0.17	0.14	0.20	0.23	0.14	0.14	0.17
96	0.43	0.54	0.41	0.31	0.15	0.11	0.15	0.08	0.00	0.22
Avg.	0.28	0.19	0.19	0.17	0.12	0.12	0.10	0.8	0.4	0.12

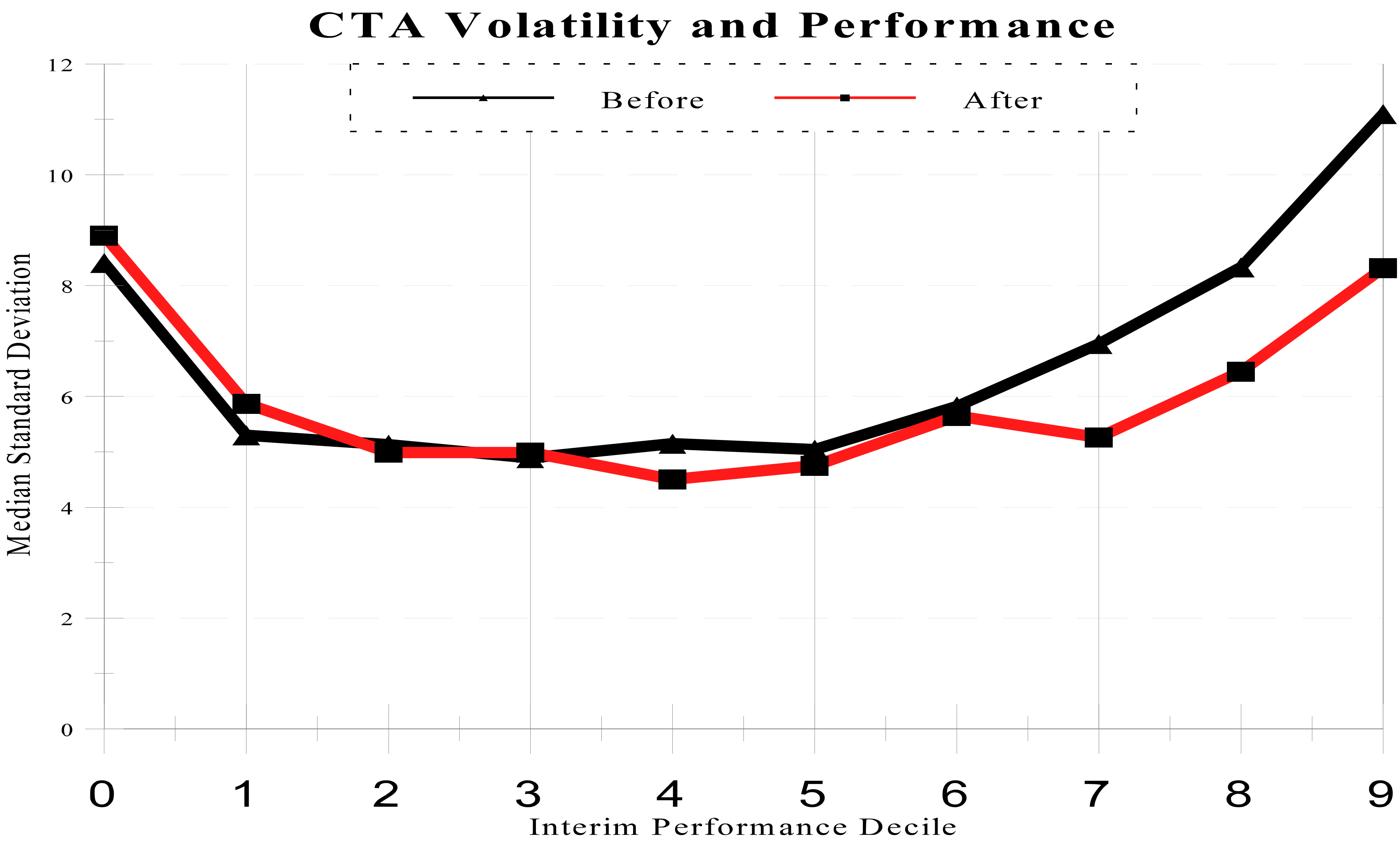
The performance measure used is running n-month average returns.
The hazard rate is the probability that an individual remaining in this decile all year will exit the database.

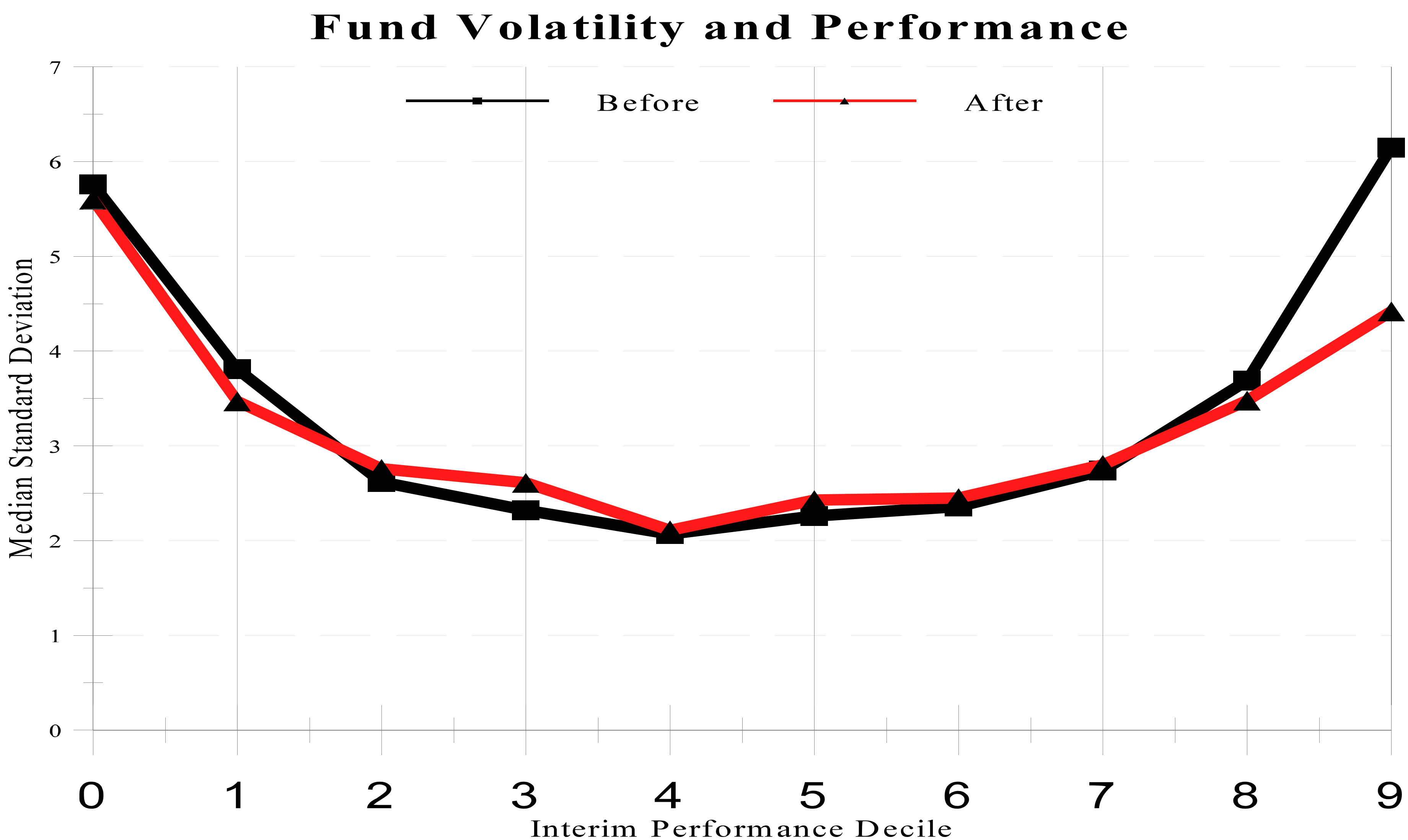
Hazard Rates by Performance

Hedge Funds (n = 10 months)

Year	Decile 0	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9
94	0.19	0.02	0.02	0.06	0.08	0.02	0.00	0.04	0.02	0.02
95	0.19	0.15	0.18	0.12	0.08	0.08	0.08	0.02	0.05	0.02
96	0.41	0.30	0.20	0.20	0.13	0.12	0.07	0.04	0.07	0.03
Avg.	0.26	0.16	0.13	0.13	0.10	0.07	0.05	0.03	0.05	0.02

Records of funds exiting the database were not kept before 1994.
The performance measure used is running n-month average returns.
The hazard rate is the probability that an individual remaining in this decile all year will exit the database.


CTA Volatility and Performance
Before
After
Median Standard Deviation
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
8
9
Interim Performance Decile


Fund Volatility and Performance
Before
After
Median Standard Deviation
0
1
2
3
4
5
6
7
0
1
2
3
4
5
6
7
8
9
Interim Performance Decile