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Hedge Fund Volatility: It's Not What You Think It Is[1]

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Many academic and practitioner studies claim that hedge funds offer a superior risk/return profile when compared to traditional asset classes, while having low to moderate correlations with these assets. Among these studies are Lamm (2000), Schneeweis and Martin (2001) and Liang (1999). We argue that some of these results could be misleading for investors. We show that there is a high degree of serial correlation in most hedge fund strategy monthly returns, which causes excess smoothness in their return series. This excess smoothness typically leads investors to understate both the true volatility of these strategies and their correlation with traditional asset classes and will significantly overstate the true Sharpe ratios, as suggested by Asness et al. (2001) and De Souza and Gokcan (2004).

In its simplest form (1 month lag), serial correlation in monthly returns implies that, for example, if we know the return in May, we can more or less know what the return will be in June. Similarly, if we know the return in June, we can more or less know what the return will be in July. In other words, there is some degree of correlation between the returns in consecutive months, which is inconsistent with the efficient market hypothesis and the random walk theory.[3]

Table 1 shows the compound annual return, annualized standard deviation and Sharpe ratio (assuming a risk free rate of 5% per annum), maximum drawdown, Conditional Value-at-Risk (CVaR hereafter) and Ljung-Box Q statistic for test serial correlation.[4] The returns vary from a minimum of 8.72% for fixed income arbitrage to a maximum of 18.07% for equity long/short. Volatility meanwhile varies from 3.25% for equity market neutral to a maximum of 9.26% for equity long/short. Fixed income arbitrage has the lowest Sharpe ratio of 0.81, while convertible arbitrage has the highest Sharpe ratio of 1.99. Fixed income arbitrage displays the highest maximum drawdown of 14.42%, followed by distressed securities with a maximum drawdown of 12.78%. However, equity long/short has the highest CVaR of 3.91% followed by global macro with a CVaR of 3.59%. Thus, it is evident from Table 1 that there is a high

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[3] Efficient market hypothesis states that any given time, security prices fully reflect all available information. The random walk theory asserts that price movements will not follow any patterns or trends, and past price movements cannot be used to predict future price movements.

[4] Maximum drawdown is the largest loss incurred from a fund's highest return to its lowest return (peak to trough) within a specific time period. CVaR is the average of the losses exceeding VaR. Maximum drawdown and CVaR are well suited risk measures for hedge funds due to large negative skew or tail risk inherent in most hedge fund strategies. The Ljung-Box Q statistic has an asymptotic χ^2_ρ distribution with ρ degrees of freedom equaling the first ρ lags. If the associated probabilities are less than 5%, the null hypothesis of no serial correlation is rejected at 95% level of confidence.

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degree of variation in the performance of hedge fund strategies. We also note a large degree of downside or tail risk in some strategies.

When we analyze the Ljung-Box Q statistic, all of the strategies show significant amounts of serial correlation except equity long/short. The cause and the degree of serial correlation differs from strategy to strategy. Serial correlation is most severe for convertible arbitrage and distressed securities strategies that are known to invest in highly illiquid high yield securities. The prevailing hypothesis is that the main reason for the existence of serially correlated returns is due to the exposure to illiquid securities. Many hedge funds trade illiquid, hard-to-price securities, which can exacerbate portfolio valuation problems. The difficulty in obtaining up-to-date prices for these illiquid or over-the-counter traded positions gives some level of latitude to hedge fund managers or administrators in pricing the positions. Requiring estimates of a current market price. This estimation creates the lags in their net asset values and causes serial correlation in their monthly returns. In addition to illiquidity exposure, deliberate smoothing of returns to adjust volatility and correlation with traditional indices may be among other causes of serially correlated returns.

Table 1: Summary Statistics – Original Index Series – January 1990 to June 2003.

Strategy	Compound Annual Return	Volatility	Sharpe Ratio*	Maximum Drawdown	Conditional Value-at-Risk	Ljung / Box Q-Statistics
Convertible Arbitrage	11.74%	3.37%	1.99	-4.84%	-1.76%	42.82 (0.0001)
Distressed Securities	15.00%	6.34%	1.58	-12.78%	-3.12%	42.12 (0.0001)
Merger Arbitrage	10.96%	4.43%	1.35	-6.46%	-2.94%	4.94 (0.02)
Fixed Income Arbitrage	8.72%	4.57%	0.81	-14.42%	-2.83%	24.30 (0.001)
Equity Market Neutral	10.11%	3.25%	1.57	-2.72%	-1.17%	23.81 (0.001)
Statistical Arbitrage	9.47%	4.01%	1.12	-5.40%	-1.76%	7.76 (0.005)
Equity Long/Short	18.07%	9.26%	1.41	-10.30%	-3.91%	3.06 (0.064)
Global Macro	17.21%	8.86%	1.38	-10.70%	-3.59%	4.62 (0.03)

Sharpe ratio assumes 5% risk-free rate.
Source: Hedge Fund Research (HFR) and CAI analysis

As we mentioned above, excess smoothness of returns caused by serial correlation will lead investors to understate true volatility and significantly overstate the Sharpe ratios. To mitigate these biases, we correct the serial correlation by using a technique called "unsmoothing". We unsmooth the original return series to create a new series from which serial correlation has been removed. This series is

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typically more volatile and its distribution function more likely to capture the true characteristics of the underlying return distributions than the originally reported return series.

This approach first tests and defines the lag of serial correlation by using Ljung-Box Q statistic. Once we determine that serial correlation exists at lag k, we use the following autoregressive model to determine the coefficient of correlation.

(1) $$R_t = \alpha_0 + \alpha_1 R_{t-k}$$

Following the same methodology in the academic literature, we then unsmooth the original return series R to create the unsmoothed (corrected for serial correlation) series R^{un} as defined by the following equation:

(2) $$R_t^{un} = \frac{(R_t - \alpha_1 R_{t-k})}{(1-\alpha_1)}$$

such that R_t^{un} displays no serial correlation.

Using the unsmoothed data, we re-calculate the summary statistics for the indices, with the results as shown in Table 2. Data unsmoothing has the following effects. Returns, as expected, are little changed. However, the standard deviations increase in all cases except for equity long/short strategy, the phenomenon that we call the "smoothness gap". It is the difference in the volatility of the original and unsmoothed return series. We demonstrate the overall effect of unsmoothing by recalculating the Sharpe ratios for all strategies and making a side-by-side comparison (see Figure 1). The net results are a decrease in Sharpe ratios across the board, most significantly for convertible arbitrage (1.99 to 1.14) and distressed securities (1.58 to 0.90). In addition, we observe higher maximum drawdowns and CVaR across all strategies except equity long/short strategy.

Table 2: Summary Statistics – Unsmoothed Index Series – January 1990 to June 2003.

Strategy	Compound Annual Return	Volatility	Sharpe Ratio*	Maximum Drawdown	Conditional Value-at-Risk	Ljung / Box Q-Statistic
Convertible Arbitrage	11.71%	5.90%	1.14	-8.22%	-3.20%	0.03 (0.84)
Distressed Securities	14.79%	10.92%	0.90	-18.21%	-5.54%	1.31 (0.25)
Merger Arbitrage	11.04%	5.08%	1.19	-7.78%	-3.41%	0.03 (0.86)
Fixed Income Arbitrage	8.49%	6.89%	0.51	-17.66%	-4.14%	0.01 (0.97)
Equity Market Neutral	9.81%	4.64%	1.04	-4.26%	-1.91%	0.49 (0.52)

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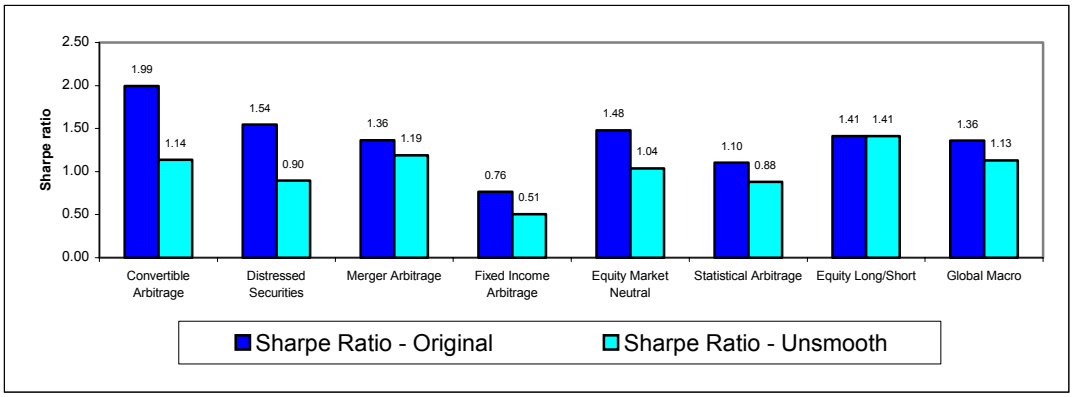
Statistical Arbitrage	9.42%	5.01%	0.88	-6.08%	-2.35%	0.07 (0.78)
Equity Long/Short	18.07%	9.26%	1.41	-10.30%	-3.91%	3.06 (0.064)
Global Macro	17.05%	10.66%	1.13	-11.45%	-4.65%	0.03 (0.86)

Sharpe ratio assumes 5% risk-free rate.
Source: CAI analysis

Figure 1: Change in Hedge Fund Sharpe Ratios Due to Unsmoothing



Source: CAI analysis

Next, in order to show the impact of unsmoothing on the portfolio construction process, we create two efficient frontiers using mean-variance optimization; one with original strategy returns and the other with unsmoothed strategy returns.[5] The two frontiers are presented in Figure 2. These frontiers support our earlier findings that for a given rate of return, portfolios constructed by using original returns understate volatility when compared to portfolios constructed by using unsmoothed returns. We notice that the degree to which volatility is understated is not the same at every point on the efficient frontier and in particular as we move to the right of the efficient frontier, the degree of understatement decreases. This is mainly because higher volatility portfolios tend to allocate more to equity long/short and global macro types of strategies where either there is little or no serial correlation. More important, the portfolios along the two efficient frontiers differ significantly. Using uncorrected returns in the optimization process results in an over-allocation to strategies like convertible arbitrage and distressed securities where we note the largest understatement of volatility or smoothness gap.

[5] We use mean-variance optimization for illustrative purposes only. However, due to the existence of non-normal return distribution and significant negative skew or tail risk in some hedge fund strategies, we believe that hedge fund

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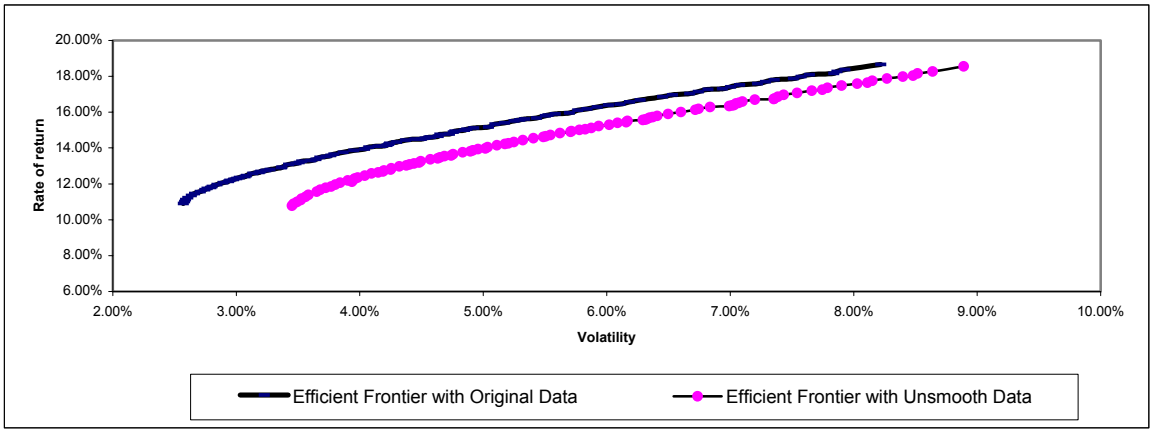
Figure 2: Mean-Variance Efficient Frontier with Original and Unsmoothed Returns



Source: CAI analysis

This article demonstrates that most hedge fund strategy returns display significant amounts of serial correlation. We illustrate a statistical technique to eliminate serial correlation and discover the true return distribution of hedge fund strategy returns. These findings have significant implications for investors who consider allocating capital to hedge funds. Finally, we note that, given the extent of the changes in volatility and the shift in the efficient frontier, the uncorrected use of hedge fund data in portfolio construction process will significantly understate risk and create systematic, but unwarranted allocation biases.

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portfolios should be optimized with respect to the risk measure that captures this phenomenon. Maximum drawdown and CVaR can be listed among the risk measures that capture the tail risk of a return distribution.