

# **Leverage Impacts on Hedge Fund Risk and Return Performance**

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## **Abstract**

As in the case of traditional investments, hedge funds are often compared on a risk-adjusted basis. Risk adjustment is of particular importance for hedge fund analysis since two funds may differ solely by leverage (on an absolute return basis), but be similar on a risk-adjusted basis. While leverage should theoretically not affect the level of risk-adjusted return within a strategy, it is possible that funds using higher levels of leverage may trade differently than funds using lower levels of leverage. In this paper, the effect of leverage on hedge fund risk and return is analyzed. Results show the level of, and degree to which, leverage used in various hedge fund strategies (above-median or below-median funds) produces superior or inferior risk-adjusted performance. While different hedge fund strategies may use different amounts of leverage, within a particular hedge fund strategy, results show little evidence of a significant difference between risk-adjusted performance of above-median and below-median leverage funds.

# Leverage Impacts on Hedge Fund Risk and Return Performance

## I. Introduction

Risk measurement and evaluation remain critical aspects of investment analysis. Extensive literature exists on single-factor and multi-factor models of risk and return estimation for traditional and alternative investments (Elton and Gruber, 1995; Daglioglu and Gupta, 2003). While considerable academic literature (Fung and Hsieh, 1997; Agarwal and Naik, 2000; Schneeweis, Kazemi and Martin, 2003) has reviewed single-factor and multi-factor market based performance measures for hedge funds, less research exists on the “microeconomic” or fund-based determinants such as leverage on hedge fund performance.<sup>1</sup>

The impact of leverage on return measurement is of particular concern for hedge fund investment analysis. Two funds may differ solely by leverage in that they may differ in terms of absolute return but may be similar on a risk-adjusted return basis.<sup>2</sup> While leverage should theoretically not affect the level of risk-adjusted return within a strategy, it is possible that funds attempting higher levels of leverage may trade differently than lower leverage funds. As a result, actual risk-adjusted performance may not be independent of leverage.

Despite the importance of leverage in risk assessment, little research exists on the impact of leverage on hedge fund risk and return. The studies that do exist, report little relationship

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<sup>1</sup> Academic research has addressed the impact of fund microstructure impacts such as fees, lockups etc. on fund performance. See Liang (1999) for an example of such research.

<sup>2</sup> In this paper, the risk-adjusted returns are presented in terms of the Sharpe ratio. The Sharpe ratio (Sharpe, 1992) is invariant to leverage as long as one can borrow or lend at the risk free rate. However, the information ratio (return/standard deviation) is not invariant to leverage unless the risk free rate is zero.

between the average monthly returns of levered and unlevered funds (Liang, 1999).<sup>3</sup> It is important to realize that the use of leverage may or may not be an essential part of certain hedge fund strategies. For instance, leverage may be a natural by-product of the trading strategy. If, for example, the strategy involves the selection of relative value positions that broadly offset exposure to the market, such strategies generate gross exposures to both sides of the relative value trade. Yet, they often require little additional net capital since the proceeds from short sales of assets may finance a substantial portion of long investments. In contrast, some hedge funds invest primarily in long-only cash instruments that involve little leverage since the underlying assets themselves have significant price volatility.

One must also remember that leverage itself is not something to be avoided. Banks, for example, are levered about 20 to 1 (about 5% of assets are equity capital, 95% are loans and deposits). Residential real estate is typically levered 5 to 1 (a 20% down payment is common, with 80% borrowed). Corporations in risky businesses such as technology stocks and automobile manufacturers tend to be financed mostly with equity because of the unpredictability of the returns. In short, the more highly levered an investment or firm is, the more care one must take to ensure that the payment flows are more predictable or else large losses are possible.

In this paper, the effect of leverage on hedge fund risk and return is analyzed. In brief, results are presented on the level of leverage used in various hedge fund strategies. Results are also provided to show the degree to which leverage, above or below the median fund leverage, determines superior or inferior risk-adjusted performance within a particular hedge fund strategy.

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<sup>3</sup> Liang (1999) does mention that leverage benefited some fund strategies such as convertible arbitrage; however, he

In the next section, the data and methodology used in this study are described. In Section III, the major findings as they relate to the potential impact of leverage on hedge fund performance are presented. Overall, the results show the following: Although different hedge fund strategies may use different amounts of leverage, within a particular hedge fund strategy, there is little evidence of a significant difference between risk-adjusted performance of above-median and below-median leveraged funds.<sup>4</sup>

## II. Data and Methodology

In this paper, we analyze the impact of leverage on various hedge fund strategies. Hedge fund strategies are generally divided into relative value, event-driven, and equity hedge-based trading strategies. Within the hedge fund universe, there are numerous possible sub-classifications. In this analysis, six commonly used hedge fund strategies are analyzed.

- **Convertible Arbitrage:** Long convertible bonds or preferred, short underlying common stock and short underlying credit risk
- **Equity Hedge:** Long or short equities, typically with a net long bias
- **Event-Driven:** Corporate transactions and special situations
- **Distressed Securities:** Long undervalued securities of companies in financial distress or operating under Chapter 11

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offers no statistical evidence.

<sup>4</sup> A wide range of quantitative measures has been suggested as means to determine the relative performance characteristics of traditional and alternative investments. Simple, single factor performance, risk-adjusted measures such as Sharpe ratios (standard deviation) and/or Treynor (beta) are commonly used to compare investments on a risk-adjusted basis. Research shows, however, firms ranked similarly by a wide range of traditional performance measures (Daglioglu and Gupta, 2003). In short, tests using various single factor performance measures will generally have similar results.

- **Merger Arbitrage:** Long/short equity securities of companies involved in corporate transactions
- **Equity Market Neutral:** Long undervalued equities and short overvalued equities, usually coordinated on a factor exposure basis

The returns and leverage usage are based on data as reported in CISDM and TASS databases (June 2003). The default source is CISDM, which provides a data field “leverage.” This represents gross leverage. Leverage data is used from TASS if no data from CISDM exists. TASS provides two fields for leverage; “average leverage” and “maximum leverage.” The latter is used only when there is no information about the average leverage. Leverage is quoted on an absolute basis. Style is determined according to classifications from CISDM, TASS, Altvest, HFR and Hedgefund.net databases. A universe of managers reporting leverage information is created. For analyses that require performance information, funds are selected based on the requirement of complete data from January 2000 through March 2003.

Leverage may be best understood as the creation of exposure greater in magnitude than the initial dollar amounts posted to an investment. It is a significant factor in the risk and return profiles of various hedge fund strategies. Leverage may be achieved through borrowing, deployment of proceeds from short sales, or through the use of derivatives.<sup>5</sup>

Leverage may be presented in various forms:

- $\text{Gross Leverage} = (\text{Longs} + \text{Shorts}) / \text{Net Asset Value}$

- Net Leverage= $(\text{Longs}-\text{Shorts})/\text{Net Asset Value}$
- Gross Longs= $(\text{Longs})/\text{Net Asset Value}$

In this analysis, a dataset of all those funds which meet the style classification criteria given above are separated into two sets: those funds that have both leverage information and 39 months of performance information from January 2000 to March 2003, and those that do not have both.

In order to test that the performance characteristics of the sample with all funds reporting leverage information do not differ significantly from the sample with funds that don't report leverage information, two equal-weighted indexes are constructed for each sample. Two types of statistical tests for comparing the two sample indexes are conducted: 1) the Welch t-test--the equivalence of means across two samples; and, 2) the Kolmogorov-Smirnov test--the equivalence of the entire return distribution. The results given in Exhibit 1 indicate that for all strategies under consideration, the indexes created from the samples were similar in terms of mean and distributional characteristics.

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<sup>5</sup> Leverage may be quoted as a ratio, percentage or as an incremental percentage, e.g. 3:1 (ratio), 300% (percentage) or 200% (incremental percentage); or 1:1, 100%, 0% for no leverage.

## Exhibit 1



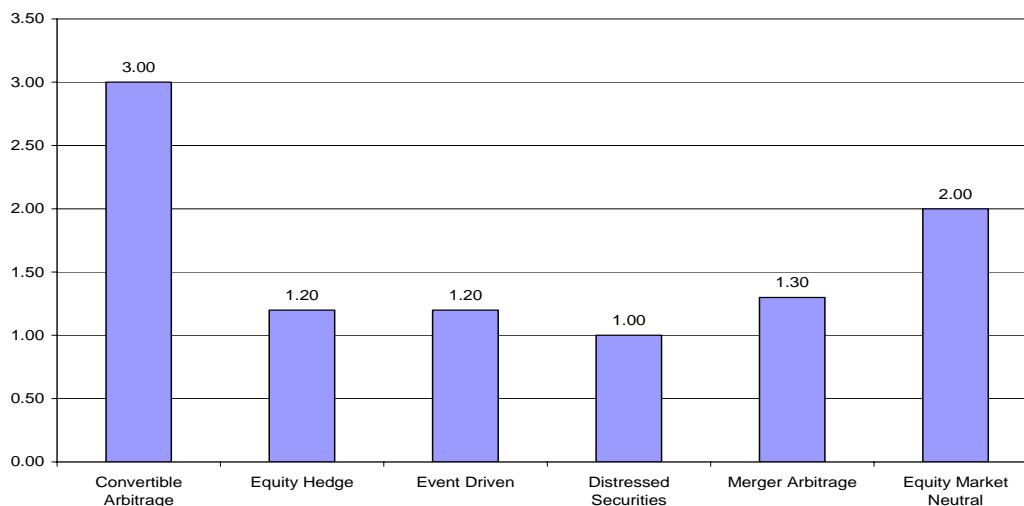
### III: Results

The median gross leverage by hedge fund strategy is reported in Exhibit 2. The risk and performance characteristics of the various hedge fund strategies are presented in Exhibit 3a and Exhibit 3b. As shown in Exhibit 3a and 3b, for the period examined, there is little direct relationship between risk and return for the various hedge fund strategies. For example, equity hedge reported the highest standard deviation, yet had one of the lowest relative returns. Similarly, event-driven reported one of the highest standard deviations, yet also had a relatively low rate of return. One reason for the lack of a consistent positive return to risk relationship across the various hedge fund strategies is that ex-post for this time period, equity markets had a relatively poor performance. For instance, for the period examined, the S&P 500 reported an average monthly return of -1.15%. Those hedge fund strategies with higher relative sensitivity to

equity markets (e.g., event-driven and equity hedge) reflect a lower average return over the period compared to those strategies that are less sensitive to the direction of equity markets (e.g., convertible arbitrage and equity market neutral).

### Exhibit 2

Median Gross Leverage by Hedge Fund Strategy  
(January 2000-March 2003)



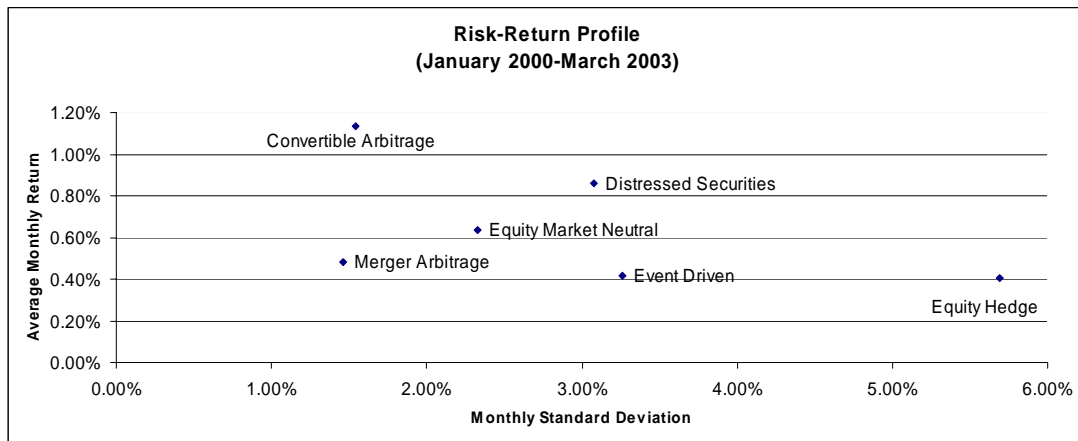
### Exhibit 3a

Descriptive Statistics  
(January 2000-March 2003)

	Average Monthly Return	Monthly Standard Deviation	Sharpe Ratio	Leverage Median	Leverage Average
Convertible Arbitrage	1.13%	1.54%	2.79	3.00	3.17
Equity Hedge	0.41%	5.69%	0.25	1.20	1.81
Event Driven	0.42%	3.26%	0.66	1.20	1.61
Distressed Securities	0.86%	3.08%	1.20	1.00	2.10
Merger Arbitrage	0.48%	1.46%	0.82	1.30	2.00
Equity Market Neutral	0.64%	2.33%	0.72	2.00	1.94

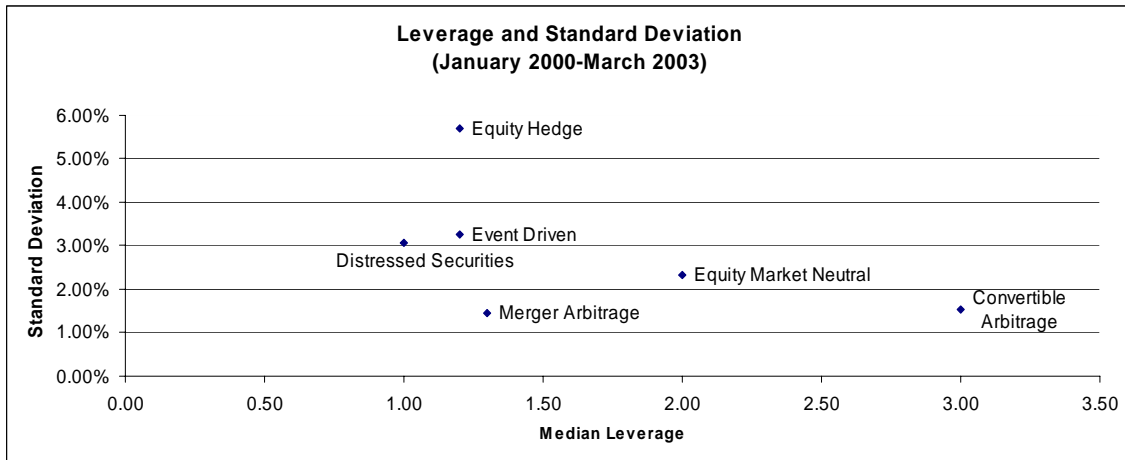
\* Sharpe Ratio based on three percent annual risk free rate

### Exhibit 3b



The results in Exhibits 3a and 3b indicate that across hedge fund strategies the return and risk relationship over the period is impacted by the various strategies' leverage. Results in Exhibit 3a show that hedge fund strategies that have relatively low risk (convertible arbitrage and equity market neutral) generally report higher leverage while hedge fund strategies with higher reported standard deviations (distressed securities, event-driven, and equity hedge) often report lower leverage. Higher risk strategies often involving directional or otherwise unhedged positions, may have higher core risk because of the lack of offsetting positions. As a result, they may require less leverage to meet the overall risk/return goals of managers. This negative relationship between leverage and volatility at the strategy level is illustrated in Exhibit 4 where strategies with the highest leverage also tend to report the lowest volatility.

## Exhibit 4



Thus while each hedge fund strategy may have a different core leverage, it remains an open question whether the use of leverage has a direct impact on a hedge fund's performance within a particular strategy. Within the hedge fund strategies analyzed here, leverage itself may not be driving volatility, but may be used, in part, to enhance returns to a level considered comparable to other similar risky traditional investments or to other hedge fund managers within the same strategy.

However, expanding leverage beyond that currently utilized within a particular strategy may not result in a proportional increase in return and risk as measured by standard deviation. This may happen because: 1) Hedge fund managers tend to adjust their trading strategy to reflect the amount of leverage that they employ, i.e. the higher the degree of leverage used, the less volatile strategy the manager is likely to select; and, 2) If a manager increases leverage without a corresponding decline in the riskiness of the underlying strategy, creditors may not be willing to bear such increased market or credit exposure and therefore may impose additional costs on the manager.

In Exhibits 5a and 5b, the correlations between median leverage and the Sharpe ratios within each strategy are presented, along with other statistics related to leverage usage and performance. The strategies showed a mixture of positive and negative relationships between fund level usage of leverage and fund Sharpe ratio. From the correlations reported, which are all in the neighborhood of zero, there does not appear to be any strong relationship between the two quantities.<sup>6</sup>

### Exhibit 5a

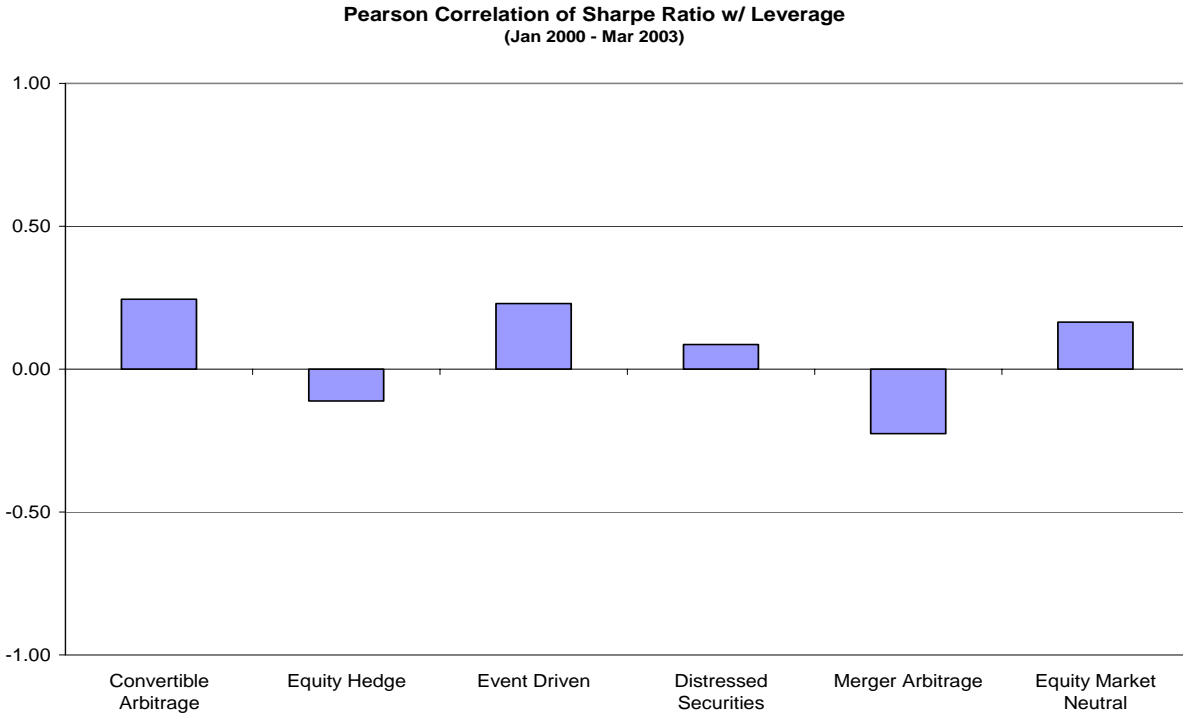
Correlation  
(January 2000-March 2003)

	Leverage/ Monthly Return	Leverage/ Standard Deviation	Leverage/ Sharpe Ratio	Return/ Standard Deviation
Convertible Arbitrage	0.28	0.16	0.24	0.83
Equity Hedge	-0.09	-0.01	-0.11	-0.27
Event Driven	0.16	-0.13	0.23	-0.70
Distressed Securities	-0.12	-0.21	0.09	-0.07
Merger Arbitrage	-0.11	0.12	-0.23	-0.68
Equity Market Neutral	-0.06	-0.12	0.16	0.38

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<sup>6</sup> For the various hedge fund strategies, the correlations between leverage and Sharpe ratio are not significant as formal statistical analysis utilizing resampling (bootstrap followed by jackknifing) shows that inferential quantities associated with these correlations are highly sensitive to data outliers.

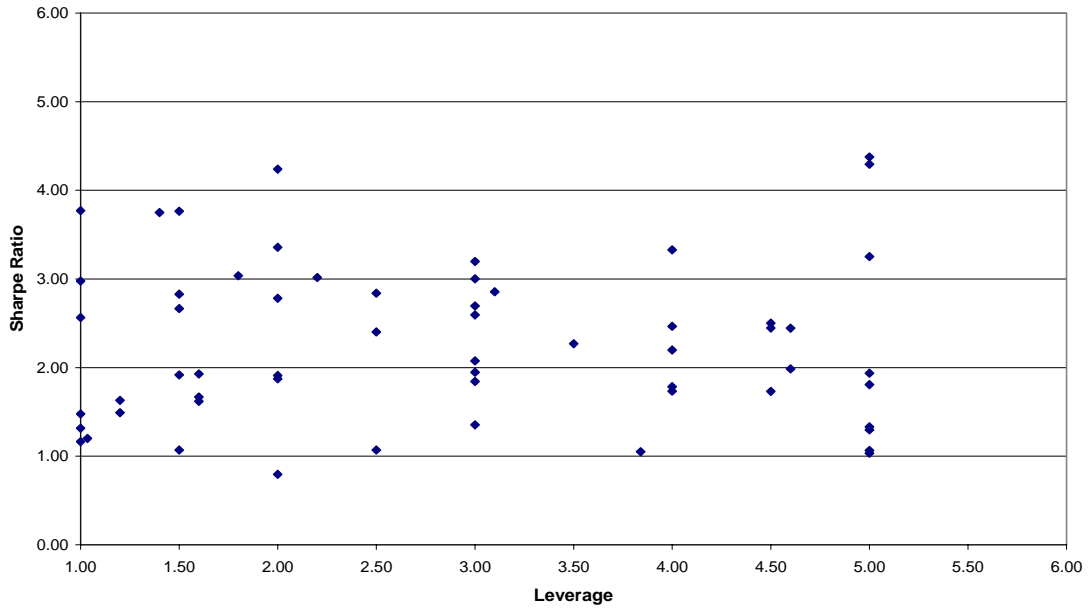
## Exhibit 5b



In Exhibits 6a through 6f, graphs of the Sharpe ratio and median leverage of individual funds are presented. Graphically, it is difficult to observe any robust patterns in the data, particularly in the center of the distributions. It should be noted that some outliers are omitted from the charts because they distort the scale of the chart without offering additional insight.

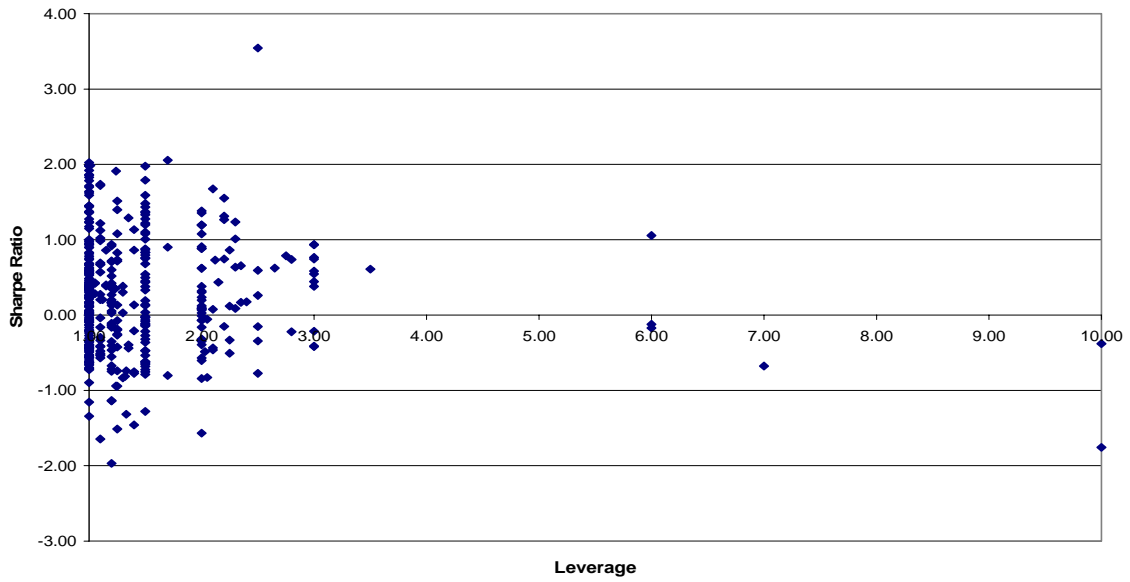
## Exhibit 6a

Convertible Arbitrage  
(Jan 2000 - Mar 2003)



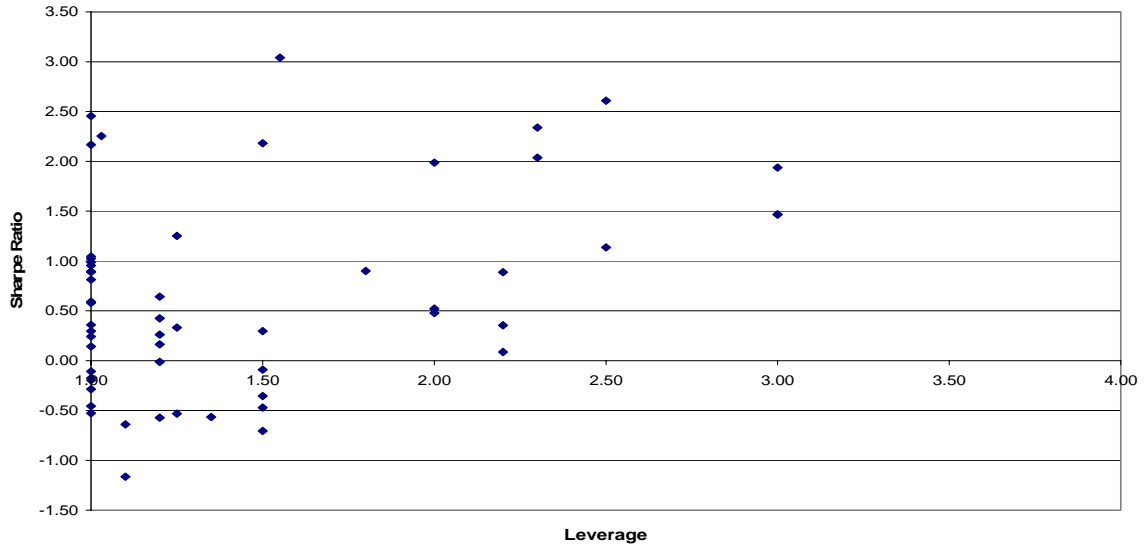
## Exhibit 6b

Equity Hedge  
(Jan 2000 - Mar 2003)



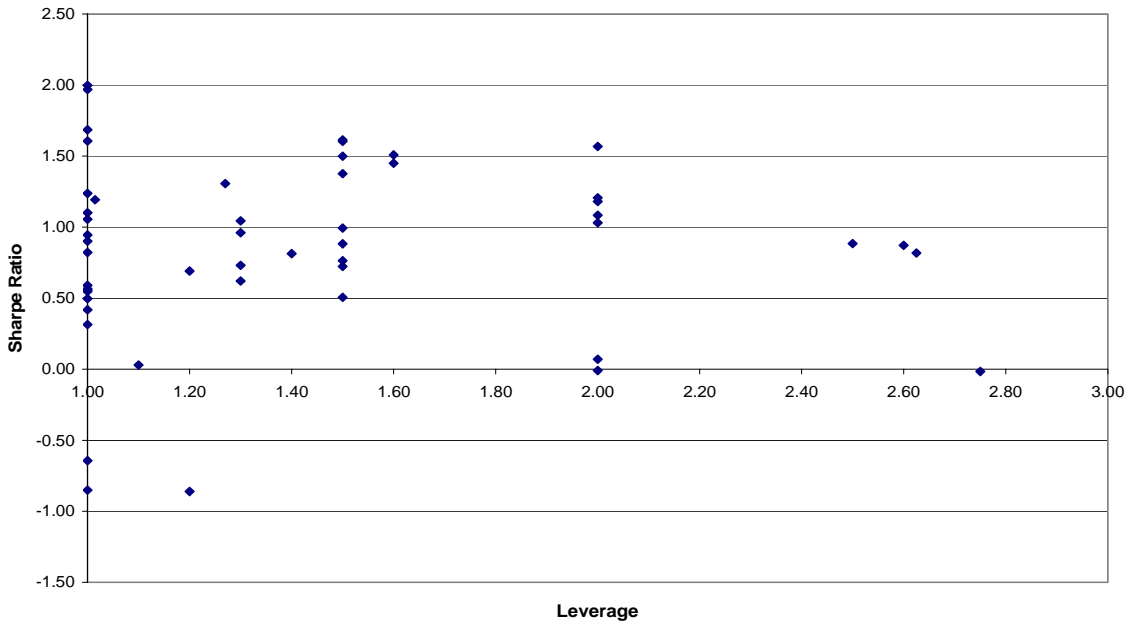
### Exhibit 6c

Event Driven  
(Jan 2000 - Mar 2003)



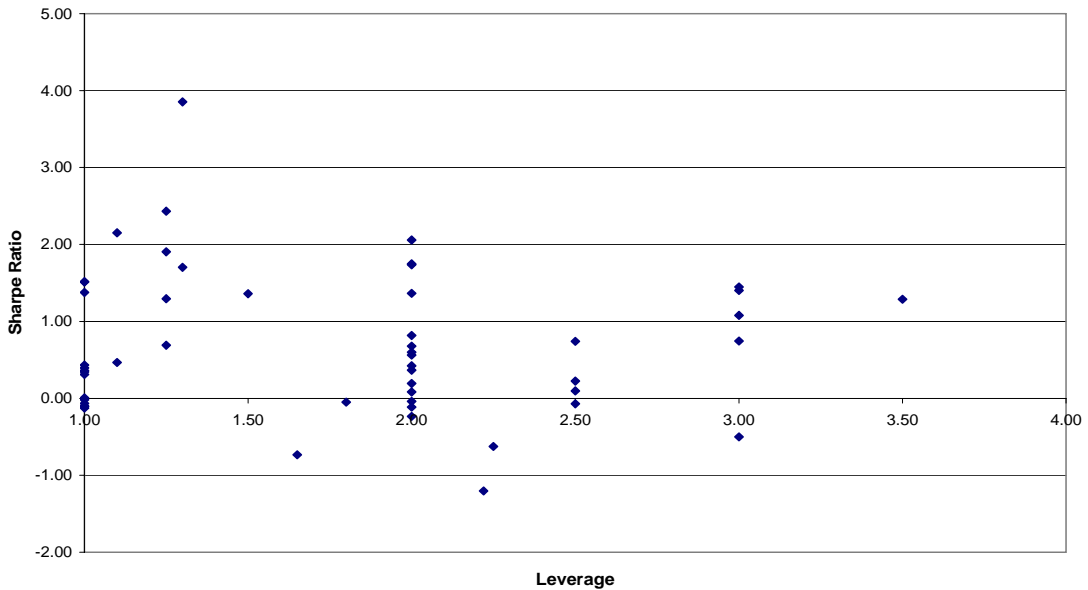
### Exhibit 6e

Merger Arbitrage  
(Jan 2000 - Mar 2003)



### Exhibit 6f

Equity Market Neutral  
(Jan 2000 - Mar 2003)



In order to test statistically whether there is a significant relationship between leverage usage and risk-adjusted performance, a more formal, and robust, median-based test is also conducted to

determine if there is any relationship between risk-adjusted performance and leverage utilization. For each strategy, funds are partitioned into two groups: those with above-median leverage and those with below-median leverage. We then test whether the corresponding median Sharpe ratio of funds in each partition is statistically different from each other.

In Exhibit 7, we report the median Sharpe ratios of the two groups; those with leverage above the median and those with leverage below the median. In Exhibit 8, we present results on the significance of the differences in median Sharpe ratios between the above-median leverage and below-median leverage samples. The test can be constructed as a 2x2 Fisher exact test. Across all strategies, we find that there is no statistically significant difference between the risk-adjusted performance of funds with below-median leverage usage and those with above-median usage.

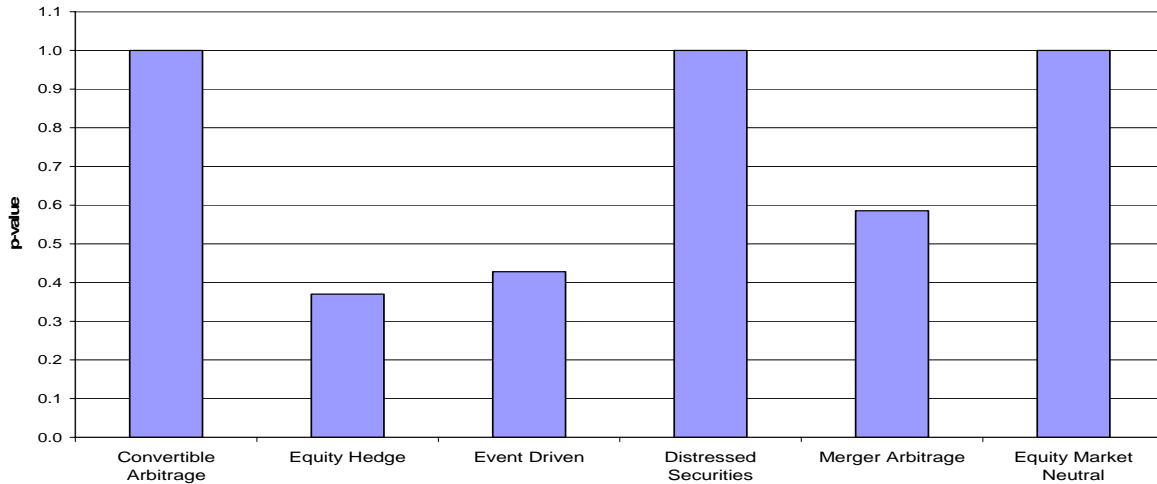
### **Exhibit 7**

Median Sharpe Ratio  
High (Greater than Median) and Low (Less than Median) Leverage

	<b>Median Hi Lev Sharpe</b>	<b>Median Low Lev Sharpe</b>
Convertible Arbitrage	2.44	2.24
Equity Hedge	0.13	0.23
Event Driven	0.89	0.33
Distressed Securities	1.02	1.34
Merger Arbitrage	0.88	0.78
Equity Market Neutral	0.74	0.45

## Exhibit 8

Probability That High Leverage Funds Have Same Sharpe Ratio  
As Low Leverage Funds (Fisher Median Test)  
Jan 2000 - Mar 2003



### IV. Summary

This paper examines empirically the impact of one particular risk factor, the usage of leverage, on the return performance of hedge funds across particular strategies. Across hedge fund strategies, a systematic relationship between standard deviation and leverage seems to exist. However, the relationship is not positive. In short, those strategies with lower volatility generally have higher leverage. Within particular hedge fund strategies, at the fund level, there is little evidence of a systematic relationship between the use of leverage and the level of risk-adjusted performance. While having hedge funds with leverage *approximately equal* to that of the median fund provides risk exposure consistent with the strategy, permitting hedge funds within a strategy to have leverage *drastically different* from the median levered fund does not seem to provide additional risk-adjusted return benefits.

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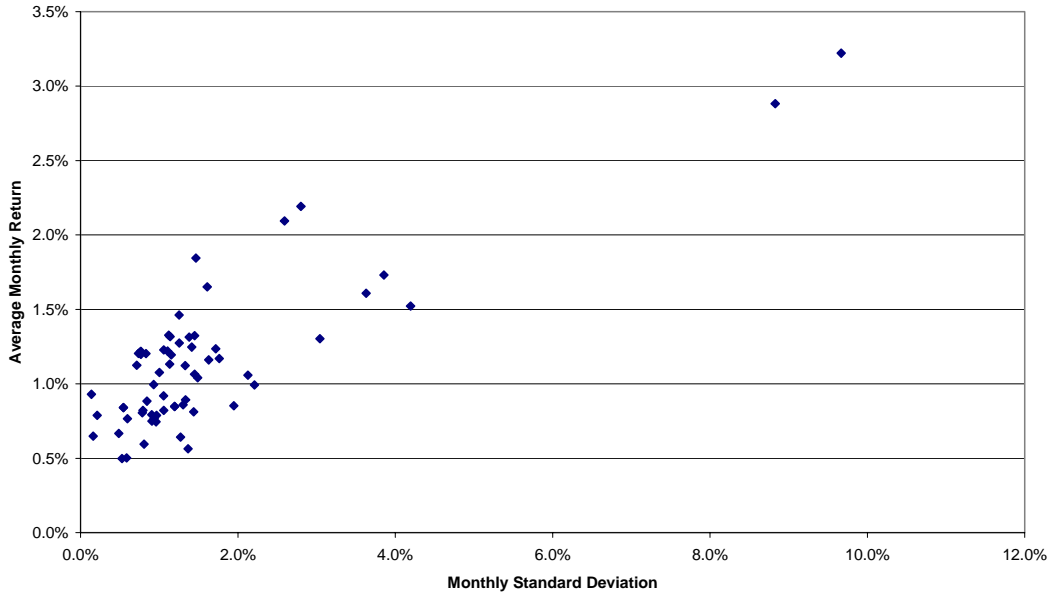
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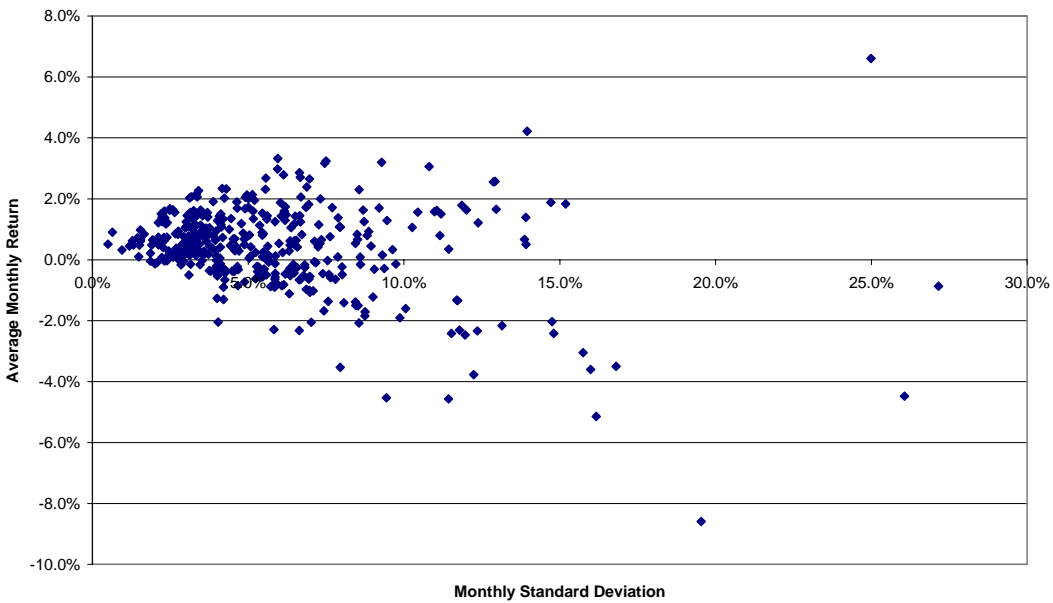
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# Appendix 1

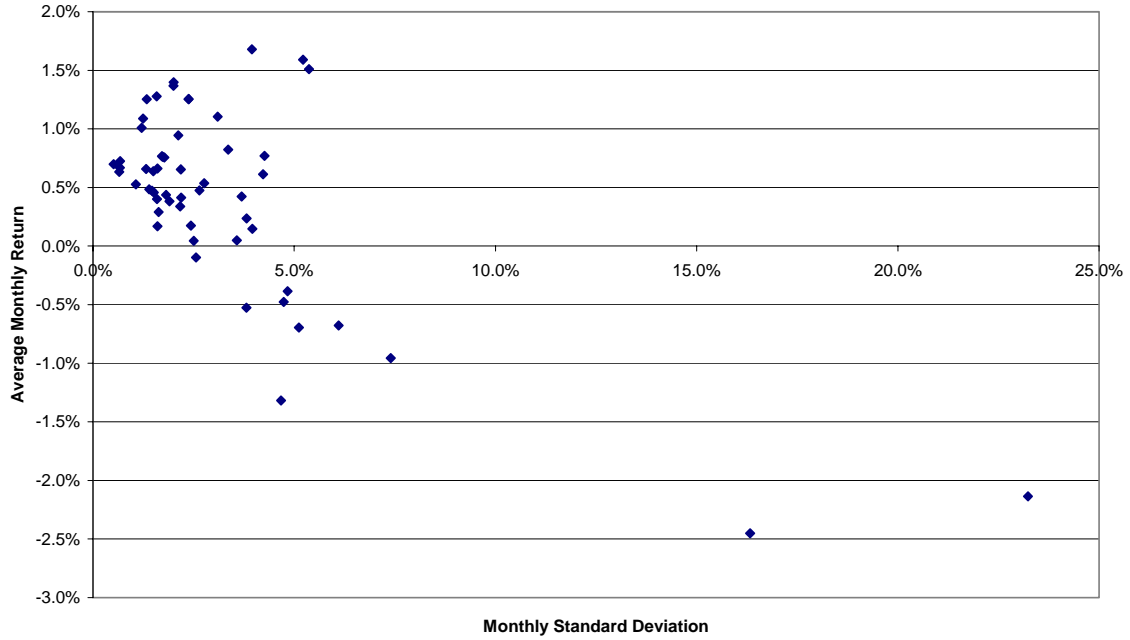
**Convertible Arbitrage**  
**Monthly Risk and Return Characteristics**  
(Jan 2000 - Mar 2003)



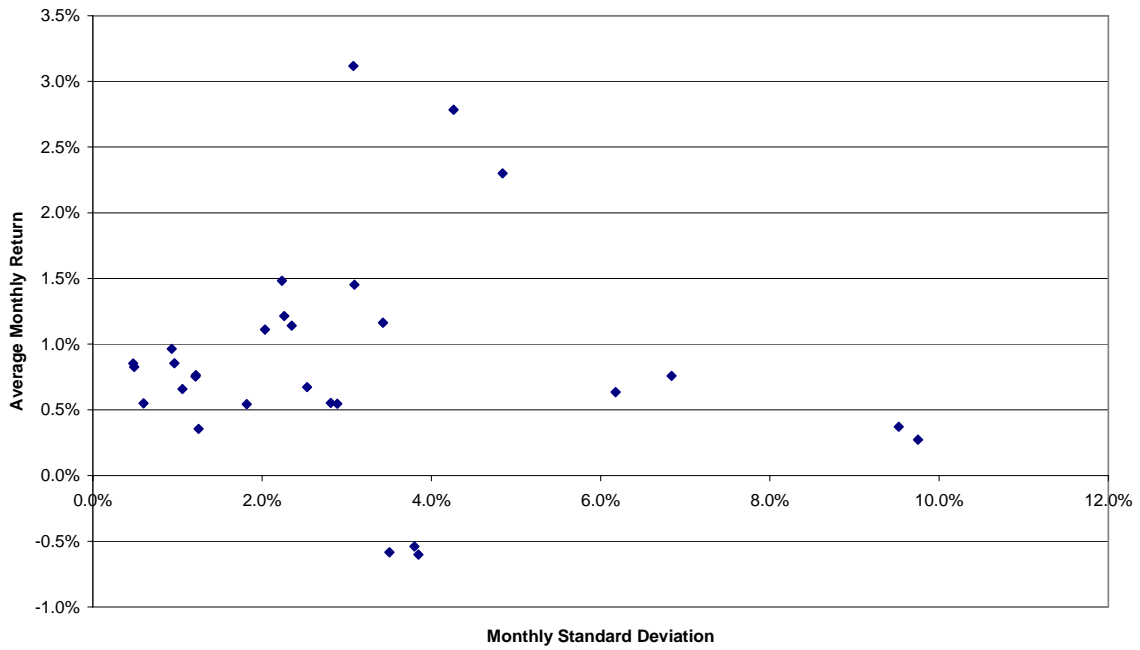
**Hedged Equity**  
**Monthly Risk and Return Characteristics**  
(Jan 2000 - Mar 2003)



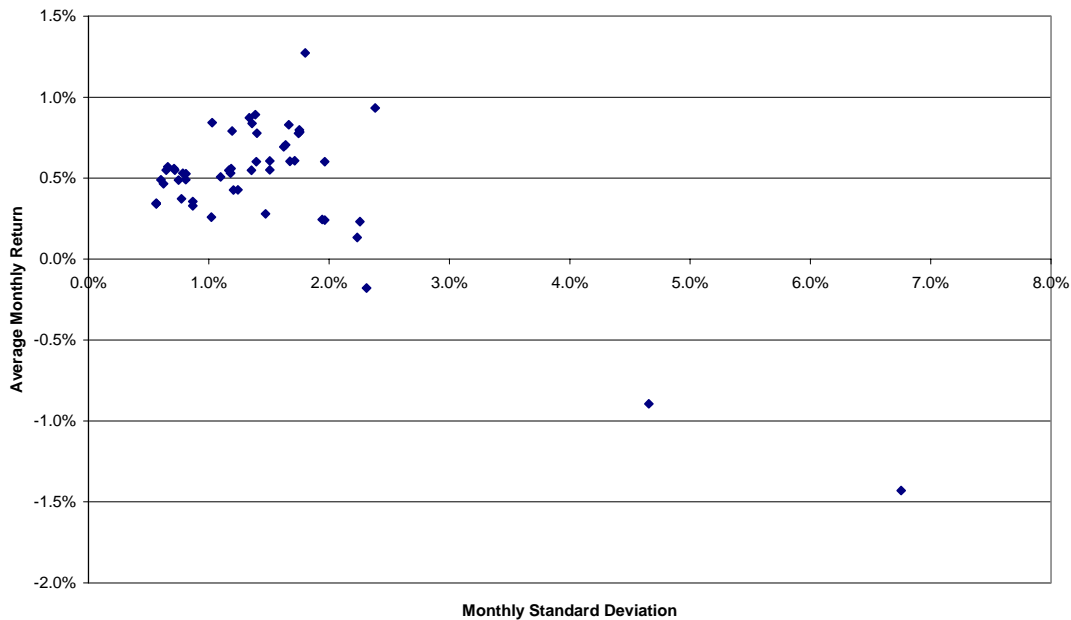
**Event Driven**  
**Monthly Risk and Return Characteristics**  
 (Jan 2000 - Mar 2003)



**Distressed Securities**  
**Monthly Risk and Return Characteristics**  
 (Jan 2000 - Mar 2003)



**Merger Arbitrage**  
**Monthly Risk and Return Characteristics**  
(Jan 2000 - Mar 2003)



**Equity Market Neutral**  
**Monthly Risk and Return Characteristics**  
(Jan 2000 - Mar 2003)

