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SHORT VOLATILITY STRATEGIES: IDENTIFICATION, MEASUREMENT, AND RISK MANAGEMENT[1]

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Many investors demand position transparency from hedge fund managers in the belief that more information is better than less. However, certain hedge fund strategies create synthetic investment positions that resemble a short put option, and these positions are not revealed by position transparency. Specifically, event-driven hedge funds and merger arbitrage hedge funds have significant exposure to volatility events. We identify and measure this short volatility exposure, providing the transparency that is lacking from position disclosure. In addition, we examine ways to manage this short volatility risk.

1 Introduction

A great debate on transparency surrounds the hedge fund industry. On one side are large institutional investors that are accustomed to receiving full transparency from their long-only investment managers. On the other, are the hedge fund managers that are reluctant to provide full position transparency. They fear that their investment strategy might be revealed to the market and their skill eroded.

Yet full position transparency may not reveal the true risk exposures of certain hedge fund strategies because the risk exposures may not be contained in the balance sheet positions. In this paper, we examine two such hedge fund strategies: merger arbitrage and event-driven. Both of these strategies result in what we label a "short volatility" exposure that is not obvious from their balance sheet positions. We begin with a brief overview of merger arbitrage and event-driven strategies. We then measure the short volatility risk exposure of these strategies. Next, we apply Monte Carlo simulation to determine the Value at Risk for short volatility strategies. Last, we offer some practical suggestions for risk management, including long volatility strategies.

2 A description of merger arbitrage and event-driven hedge fund strategies

Merger arbitrage and event-driven strategies are often referred to as absolute return strategies because their return expectations are not driven by the

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market return, but instead, by the specific dynamics of individual corporate transactions. More specifically, their return expectations are an absolute level of return sufficient to compensate them for the risk associated with significant corporate transactions. This absolute level is established independently of the return on the market.

Merger arbitrage seems like a simple strategy to effect. The hedge fund manager purchases the stock of the target company and sells the stock of the acquiring company. Typically, the stock price of the target company increases at the announcement of the merger and may continue to increase until the merger is completed. Mergers usually result in the bidding company "upping the ante" once they begin the process. Conversely, the price of the acquiring company usually declines at the time of the announcement and may continue downward if the bidding company increases its bid for the target.

Once a merger is announced, there is typically a spread between the prices of the acquiring company's stock and that of the target company's stock. This spread is what the merger arbitrage manager locks in by buying the stock of the target company and shorting the stock of the acquiring company. If the merger is successfully completed, the stock prices of the two companies must converge to one price because they will become one company. This convergence is the profit that the merger arbitrage manager will earn, and the merger arbitrage manager will earn the spread it previously locked in as its reward.

Consider the merger announcement that company A will merge with company B in a one for one stock swap; one share of company A stock for one share of company B stock. After the announcement, company A's stock price is $50 and company B's stock price is $45. The merger spread is $5. This is the premium that the hedge fund manager expects to earn. The hedge fund manager will short company A's stock at $50 and buy company B's stock at $45.

At the closing of the merger, the stock prices of the two companies must converge because they will become one company. Either company A's stock will decline (and the hedge fund manager will make money on its short position in A stock) or company B's stock will increase (and the hedge fund manager will make money on its long position in B stock). Alternatively, the merged company may end up with a stock price between $45 and $50 and the hedge fund manager will make money on both its short position in company A and its long position in company B. However, the maximum profit the merger arbitrage manager can earn is the merger spread of $5.

Merger arbitrage managers take a bet that the merger will be completed. They will analyze antitrust regulations, consider whether the bid by the acquiring company is hostile or friendly, and check on potential shareholder opposition to the merger. If the merger is completed, the merger arbitrage manager will earn the spread that it previously locked in through its long and short stock positions. However, if the merger falls through, the merger arbitrage manager may incur a considerable loss that cannot be known in advance.

From this perspective, merger arbitrage hedge funds can be viewed as merger insurance agents. They insure against the risk of loss should the merger deal collapse. By buying the stock of the target company and selling the stock of the acquiring company stock from investors who do not have as much confidence in the merger deal, merger arbitrage hedge funds accept/insure against the risk of the deal collapsing.

If the merger is successfully completed, the merger arbitrage manager will collect a known premium (the spread it previously locked in). However, if the merger fails to be completed, the merger arbitrage

manager is on the hook for the loss instead of the shareholders from whom he purchased or sold shares. In essence, shareholders of the two companies can "put" their losses back to the merger arbitrage manager if the deal falls through.

This asymmetric insurance contract payoff exactly describes that of a short put option exposure. The hedge fund manager sells the put option, collects the option premium and increases his total return. If the option expires unexercised (the merger is successfully completed), the hedge fund manager gets to keep the premium. However, if the option is exercised against the hedge fund manager (the merger deal collapses), the loss can be substantial.[2]

The key point of this discussion is that the short put option exposure of the merger arbitrage manager is not recorded on the balance sheet. If an investor were to examine the merger arbitrage manager's balance sheet positions, she would see corresponding long and short equity positions. From this the investor might conclude that she is exposed to net stock market risk, the same as an equity long/short hedge fund manager. However, off the balance sheet of the merger arbitrage manager exists a real and dangerous risk, the outstanding short put option position.

The problem is that the short put option exposure is synthetic, it cannot be identified by looking at the manager's long and short equity positions. Therefore, position transparency will not reveal the true risk profile of the hedge fund manager. The merger arbitrage manager is exposed to a "volatility event" (the merger breaks down). This is what we mean by having a "short volatility" exposure.

Event-driven hedge funds face a similar short volatility exposure. Event-driven managers concentrate on significant corporate events including mergers, acquisitions, spin-offs, re-structurings, re-capitalizations, and any other transaction that can have a significant impact on the share price of the company.

For example, a parent company may consider the sale of a large equity interest in a publicly traded subsidiary. Corporations frequently reassess their strategic plan, refocusing on core strategies and selling those divisions or subsidiaries that are not part of the long-term plan. Frequently, the parent company's stock will trade up on the announcement of the refocused vision while the subsidiary's stock may trade down because of the expected dilution from the public sale of the parent company's equity interest. This provides the event-driven manager with the opportunity to buy the parent company's stock and to short the subsidiary company's stock in anticipation that the transaction will be completed.

The dangers of selling options has been previously discussed. Lo (2001), Weisman (2002) and Anson (2002b) all demonstrate that investment strategies that write options will be falsely accorded superior performance based on a mean–variance analysis. We extend the literature by documenting synthetic short volatility strategies, measuring their risk, and providing a method to manage the risk.

3 A demonstration of a short put option

In this section we use the direction of the stock market to demonstrate the asymmetric payout associated with merger arbitrage and event-driven hedge fund strategies. That is, we expect that large downward movements in the stock market will result in large losses incurred by merger arbitrage and event-driven hedge funds. Conversely, we expect that large positive movements in the stock market will result in a constant premium earned by merger arbitrage and event-driven hedge funds. This type of return pattern is consistent with a short put option exposure. Therefore, this section plots the direction of the stock market versus the returns earned by merger

arbitrage and event-driven strategies. In Section 5 we specifically incorporate a measure of volatility to determine its impact on these hedge fund strategies.[3]

We use the Hedge Fund Research Inc. database to obtain the returns associated with merger arbitrage and event-driven hedge fund managers.[4] We start by plotting a scatter plot of the excess return to event-driven hedge fund returns versus the excess returns to the S&P 100.[5] We use the S&P 100 because this is the underlying index for which the VIX volatility index is calculated. We will use the VIX index in the next section. This scatter plot is presented in Figure 1.

On top of the scatter plot in Figure 1, we fit a regression line to plot the excess return to event-driven hedge funds dependent upon the excess return to the S&P 100. Note that the fitted regression line is "kinked" around an excess return of 0%. The kink in the regression line indicates that there are really two observable relationships between the S&P 100 excess returns and the excess returns to event-driven hedge funds.

To the right of the kink, the excess returns to the S&P 100 are positive. In this part of the graph, the relationship between the returns earned by the event-driven managers and the S&P 100 appears orthogonal. That is, there is no apparent relationship between the returns to event-driven hedge funds and the returns to S&P 100, when the returns to the S&P 100 are positive. This is another way of saying that the returns to event-driven hedge funds are not dependent upon the returns from the general

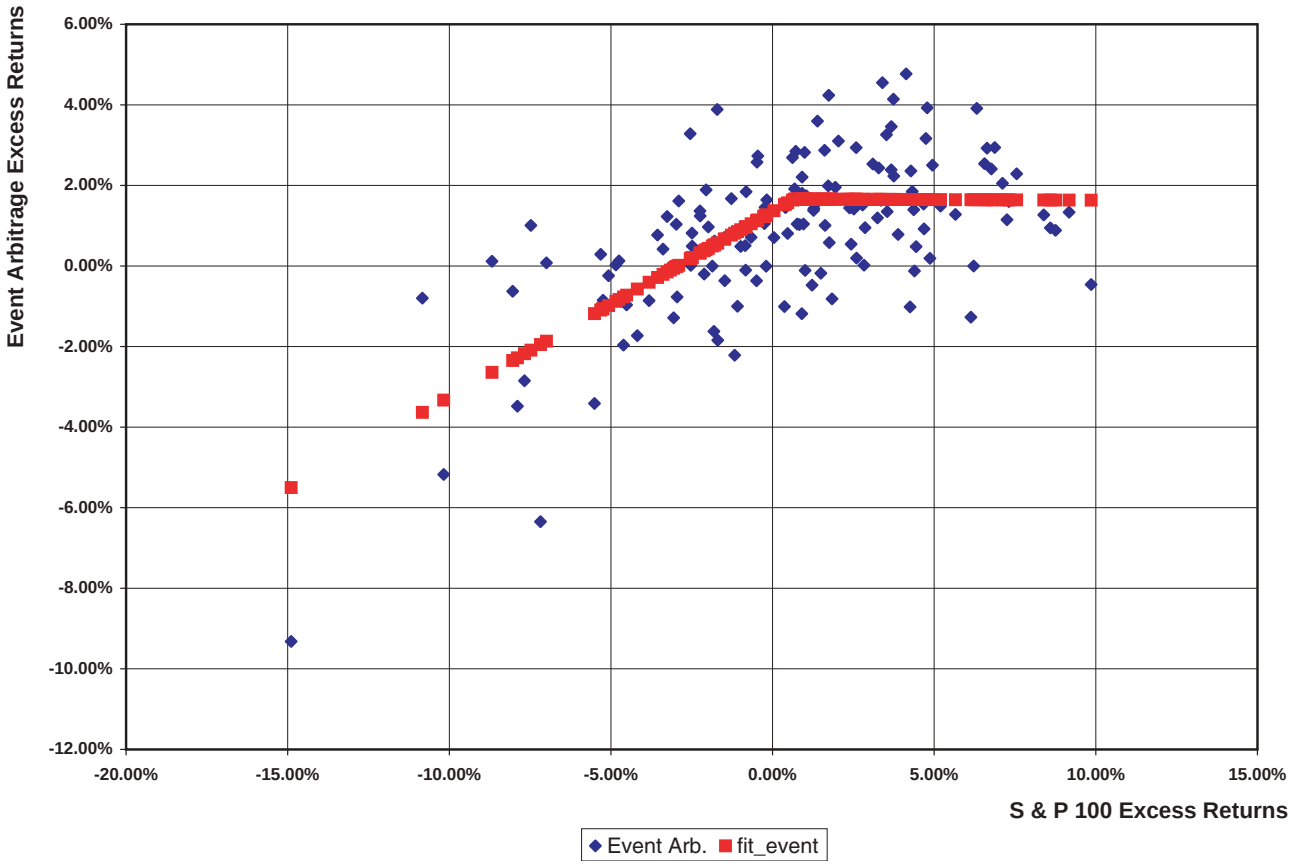


Figure 1 Event driven.

stock market as long as the stock market has positive returns.

Event-driven hedge funds earn a consistent return regardless of how positive the stock market performs. This is the collection of the option or insurance premium. As long as there is no volatility event that drives down stock prices, the event-driven hedge fund manager collects the synthetic put option premium and banks it.

However, to the left-hand side of the kink, there is a distinct linear relationship between the returns to event-driven hedge funds and the S&P 100. Declines in the stock market driven by volatility events also result in negative returns for event driven hedge funds. In fact, the fitted regression line in Figure 1 mirrors the payoff function for a short put option.

Figure 2 provides a scatter plot for the excess returns to merger arbitrage compared to the excess returns to the stock market. The fitted regression line is very similar to that for event-driven hedge fund returns. Once again, we see very little relationship between the excess returns to merger arbitrage and the excess returns to the stock market to the right-hand side of the kink in the regression.

This portion of the regression line represents the collection of option premium. Merger arbitrage managers earn a consistent, stable return as long as the stock market returns are positive. However, when the stock market returns are affected by

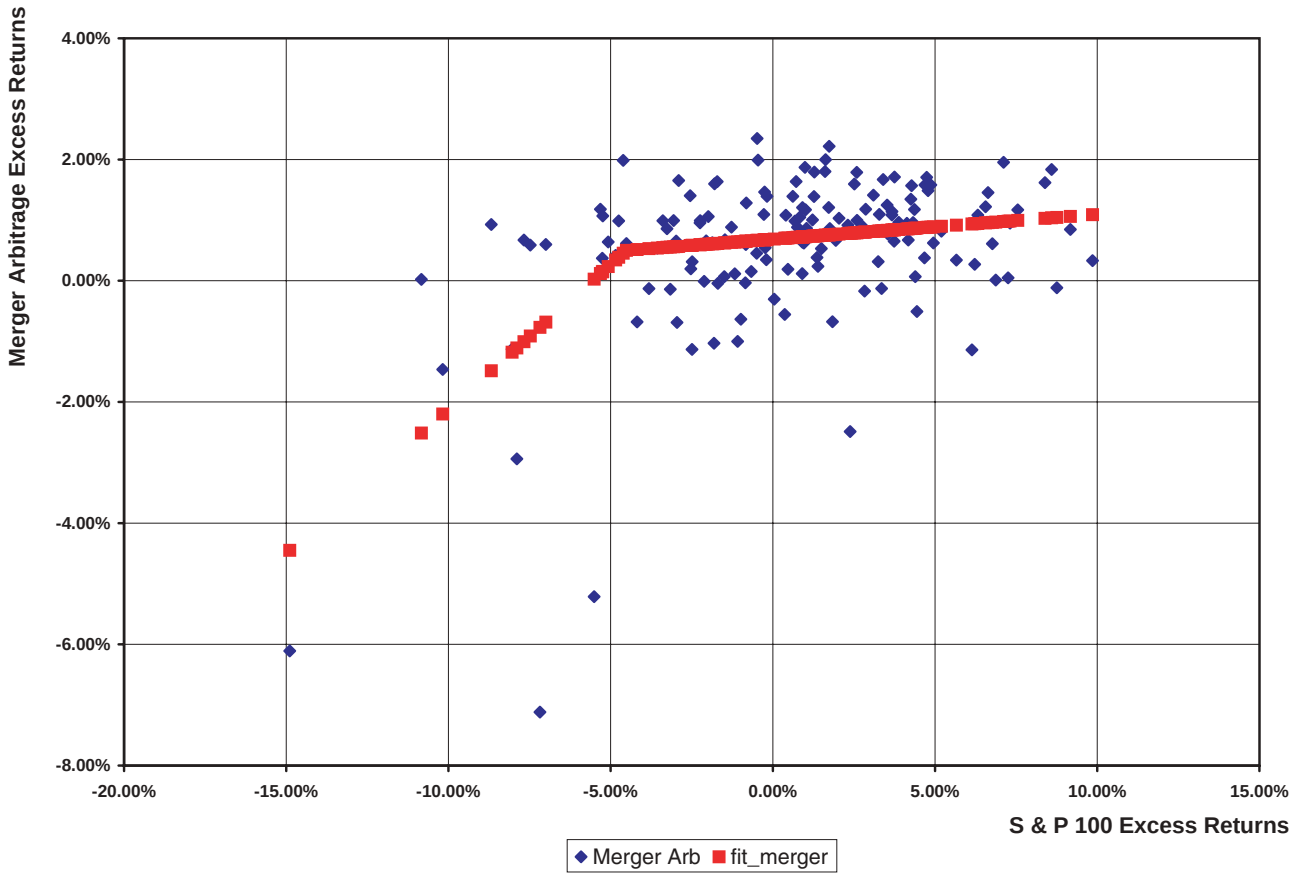


Figure 2 Merger arbitrage.

volatility events, merger arbitrage managers suffer losses. This is the part of the synthetic short put option where the option is in the money and the merger arbitrage managers lose money.

4 Fitting the regression line

The discussion above provides a general framework in which to describe empirically short volatility hedge fund strategies. To fit the kinked regression demonstrated in Figures 1 and 2, we use a piecewise linear CAPM-type model. The model can be described as

$$R_{\text{hf}} - R_{\text{f}} = (1 - D)[\alpha_{\text{low}} + \beta_{\text{low}}(R_{\text{OEX}} - R_{\text{f}})] + D[\alpha_{\text{high}} + \beta_{\text{high}}(R_{\text{OEX}} - R_{\text{f}})] \quad (1)$$

where R_{hf} is the return to the hedge fund strategy (event-driven or merger arbitrage), R_{f} is the risk free rate, R_{OEX} is the return to the S&P 100, α_{low}, β_{low} are the regression coefficients to the left-hand side of the "kink" and α_{high}, β_{high} are the regression coefficients to the right-hand side of the "kink". $D = 1$ if $R_{\text{OEX}} - R_{\text{f}} >$ the threshold and $D = 0$ if $R_{\text{OEX}} - R_{\text{f}} <$ or equal to the threshold.

In essence, we plot two regression lines that have different α and β coefficients depending upon which side of the kink the market returns fall. The trick is to maintain continuity at the kink in the fitted regression line. To insure this, we impose the following condition:

$$\alpha_{\text{low}} + \beta_{\text{low}}(\text{threshold}) = \alpha_{\text{high}} + \beta_{\text{high}}(\text{threshold}) \quad (2)$$

Our regression equation then becomes:

$$R_{\text{hf}} - R_{\text{f}} = (1 - D)[\alpha_{\text{low}} + \beta_{\text{low}}(R_{\text{OEX}} - R_{\text{f}})] + D[(\alpha_{\text{low}} + (\beta_{\text{low}} - \beta_{\text{high}})(\text{threshold}) + \beta_{\text{high}}(R_{\text{OEX}} - R_{\text{f}})] \quad (3)$$

We express our regression equation in this fashion to demonstrate how the threshold value is explicitly incorporated into the solution. Figure 3 presents the results for our fitted regression lines.

	Event Arbitrage		Merger Arbitrage	
	Coefficient	t-Statistic	Coefficient	t-Statistic
Threshold	0.007	#N/A	-0.045	#N/A
Alpha low	0.014	7.566	0.027	5.670
Beta low	0.460	9.494	0.477	6.088
Alpha high	0.017	#N/A	0.007	#N/A
Beta high	-0.003	-0.051	0.041	1.501
S.E. Regression	0.015		0.011	
R square	0.444		0.279	
Adj R Square	0.436		0.269	

Figure 3 Regression statistics for event driven and merger arbitrage.

For event arbitrage, the threshold value (the "kink") is close to 0 excess return (0.67%).[6] Several observations can be made from the regression coefficients. First, the values of α_{low} and β_{low} are both significant at the 0.01% level with both t statistics over 7.5. This clearly demonstrates that when the returns to the S&P 100 are negative, the event-driven hedge fund managers also suffer losses. Using the values of α_{low} and β_{low}, event-driven managers lose, on an average monthly basis, 1.81% for every 1% decline in the S&P 100 below the threshold value.

This is similar to a put option being "put" to the hedge fund manager when the returns to the stock market are negative. This is the nature of the short volatility bias. The hedge fund manager shorts volatility through the sale of synthetic put options to collect the option premium. All works fine as long as the stock market returns remain positive. However, when the stock market suffers a negative volatility event that drives the market returns into negative territory, the synthetic put option is exercised against the hedge fund manager, leading to large negative returns.

Conversely, the coefficient for β_{high} (-0.003) is not economically significant. Also, the t statistic for β_{high} demonstrates that it is statistically insignificant from zero.[7] This is as it should be. When the returns to the S&P 100 are positive, the event-driven hedge fund manager collects the premium

from his synthetic short option position. There is no upside beyond the collection of the option premium; the size of the premium does not change as long as the returns to the stock market are positive. Therefore, the returns to event-driven hedge fund managers are orthogonal to positive stock market returns. The option premium is equal to α_{high}, about 1.66% per month.

For merger arbitrage we find similar results. However, the kink or threshold is more negative (-4.5%) than that for event-driven strategies. This could be for a number of reasons. First, it could be the nature of merger arbitrage—when things go bad, they get really ugly. In other words, when a merger agreement breaks up, merger arbitrage managers suffer larger losses than event-driven hedge fund managers. Also, event driven hedge fund managers are more diversified in their investment process. They consider many other corporate transactions beyond mergers.

The coefficients for α_{low} and β_{low} are economically significant at 2.65% and 0.4768, respectively. This indicates that for every 1% decline in the market returns below the threshold value, merger arbitrage managers stand to lose, on an average monthly basis, 3.13%.

Similar to event-driven hedge fund managers, the values of α_{low} and β_{low} are also statistically significant at the 0.01% level, indicating that merger arbitrage managers suffer greater losses the greater the decline in the stock market. Also, the coefficient for β_{high} (0.041) for merger arbitrage is not statistically significant even at the 10% level, but is larger than that for event-driven strategies. This indicates that there is some residual market risk (although not statistically significant) associated with merger arbitrage even in up markets. This could be due to the fact that there tends to be greater merger activity when the stock market performs well as opposed to when it performs poorly. Finally, the option premium, equal to α_{high}, is about 0.7% per month.

Finally, the adjusted R^2 measures for both regression lines are large—44% for event-driven hedge fund returns and 27% for merger arbitrage hedge fund returns. This indicates that a good portion of the returns to merger arbitrage and event-driven hedge fund strategies is derived from a short volatility strategy.

5 Mimicking portfolio

In this section we specifically incorporate the short volatility exposure of merger arbitrage and event-driven hedge fund managers to build mimicking portfolios of these strategies. The idea is that if we can build portfolios of securities that mimic the returns to merger arbitrage and event-driven strategies, we can then simulate how merger arbitrage and event-driven hedge fund managers should perform under various market conditions.

We use three components to build the mimicking portfolios: short OEX put options, the long S&P 100 index, and the long one month risk-free treasury security. The short OEX put option is used to capture the synthetic short put option embedded within a merger arbitrage or event-driven hedge fund strategy. The long S&P 100 index is used to capture any residual market risk that exists when the market performs positively. This was more notable for our merger arbitrage strategy where this strategy had a small (but insignificant) positive slope to the right-hand side of the threshold value in Figure 2. Finally, we use the risk free rate to capture the consistent option premium earned by merger arbitrage and event-driven managers to the right-hand side of the threshold value (when the stock market performs positively). We use the coefficient estimates from Eq. (3) to construct the mimicking portfolio.

Short OEX Put Option:
Strike = OEX index × (1 + threshold + risk-free rate)
Volatility = VIX index
The number of options sold = $(\beta_{low} - \beta_{high})$
The long S&P 100
The number of S&P 100 to buy is equal to β_{high}
Long risk free security
The number of risk free securities to buy = $1 - \beta_{low}$

The results from our mimicking portfolios are presented in Figures 4 and 5. Similar to Figure 1, Figure 4 contains the scatter plot of the excess returns earned by event-driven hedge fund managers plotted against the excess returns of the S&P 100. In addition, Figure 4, contains the regression line plotted by our mimicking portfolio.

Our mimicking portfolio performs relatively well and has the same characteristics of the fitted regression line in Figure 1. First, the mimicking portfolio has a distinct "kink" near zero excess returns. Additionally, the slope of the mimicking portfolio is flat to the right-hand side of the kink and has a positive slope to the left-hand side of the kink. In sum, our mimicking portfolio captures the premium collection attributes of an event-driven hedge fund strategy as well as the downside short put option exposure.

Figure 5 provides similar information for merger arbitrage. Once again, a scatter plot of excess merger arbitrage returns is plotted against the excess return for the S&P 100. In addition, we plot the returns from our mimicking portfolio. We can see that to the right of the kink there is a slight positive slope

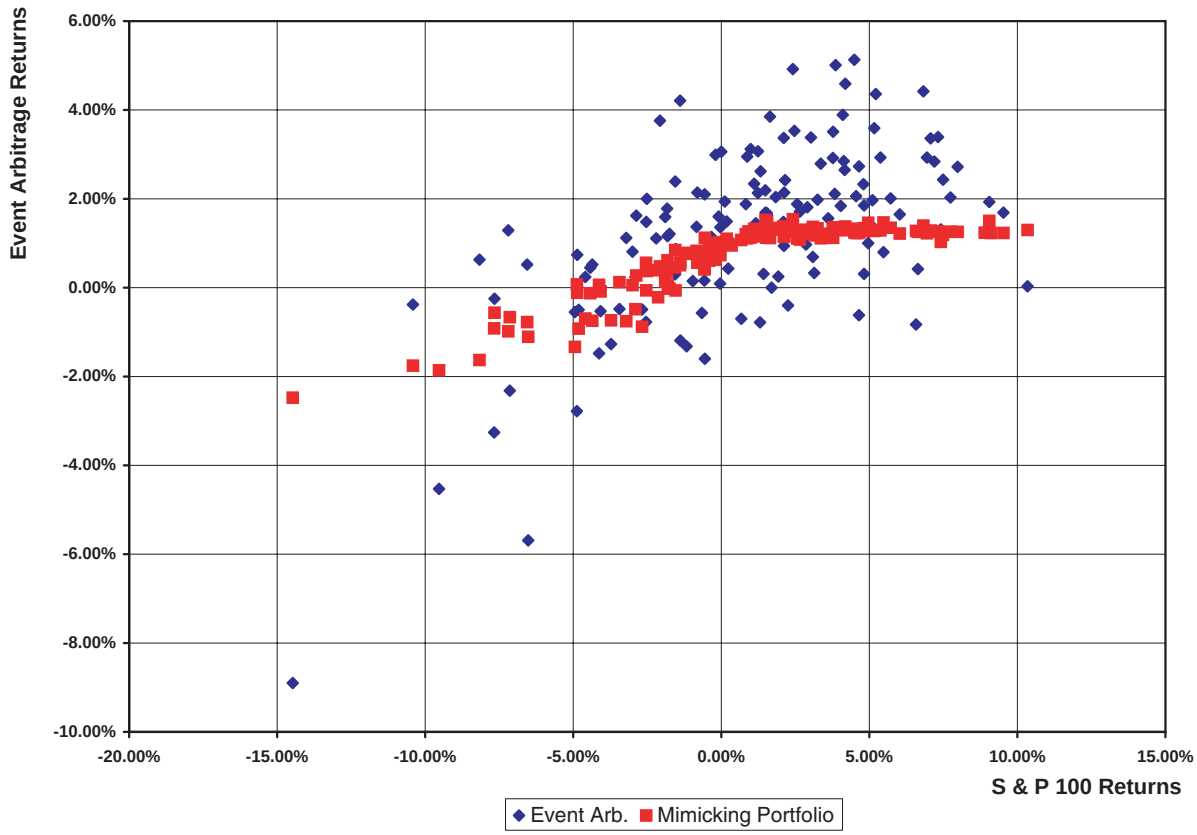


Figure 4 Event arbitrage and mimicking portfolio returns.

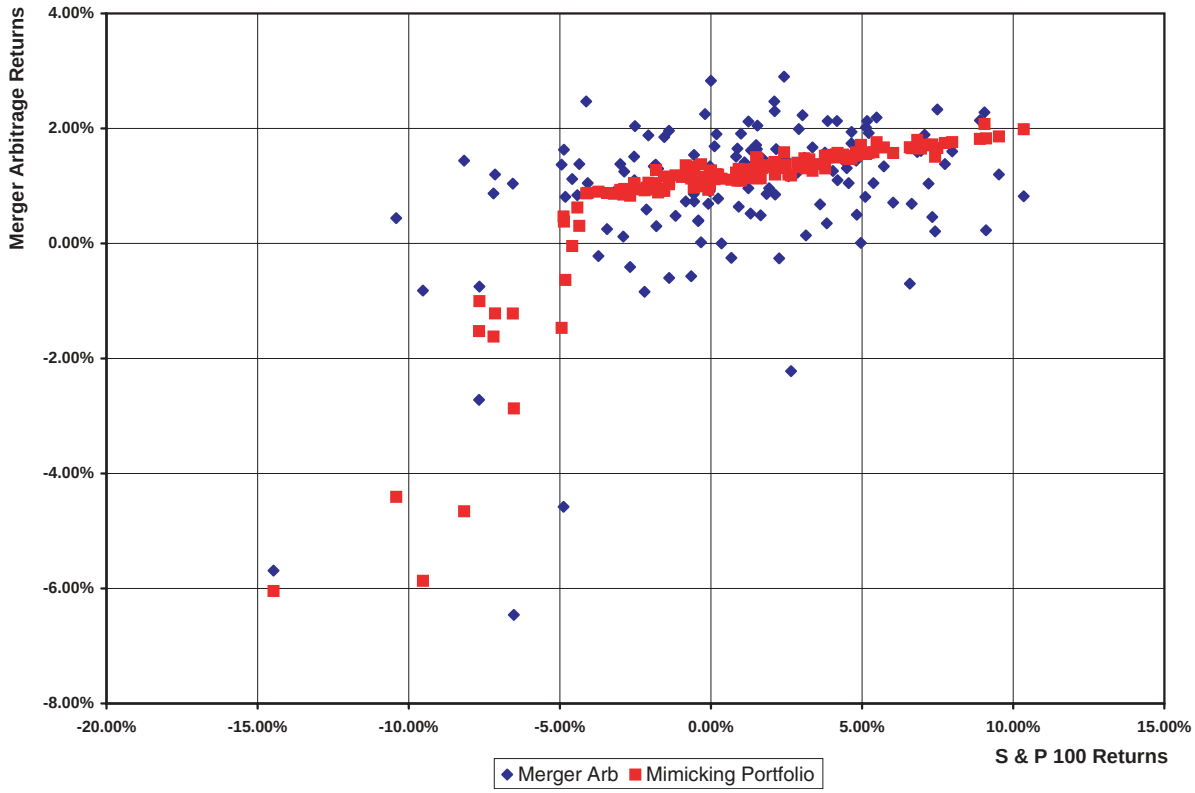


Figure 5 Merger arbitrage and mimicking portfolio returns.

to our mimicking portfolio just as there was for the fitted regression line for merger arbitrage returns. In addition, to the left-hand side of the kink, there is a significant downside risk indicative of a short put option exposure.

In summary, we are able to build mimicking portfolios using traditional securities that mimic the return patterns of merger arbitrage and event-driven hedge funds. Specifically, these mimicking portfolios capture both the short volatility exposure of a short put option as well as the premium collection when all performs well. Our next step is to provide some value at risk analysis.

6 Value at risk for merger arbitrage and event-driven hedge funds

The important reason for building mimicking portfolios is that we can simulate the returns to event-driven and merger arbitrage trading strategies for developing risk estimates. Specifically, we can run Monte Carlo simulations with our mimicking portfolios and develop Value at Risk (VAR) statistics. Armed with this data we can estimate the probability of the risk of loss associated with short volatility strategies. This is important to help us understand the off-balance sheet risks associated with event-driven and merger arbitrage hedge fund strategies.

In addition, we can use the Monte Carlo simulations to plot the frequency distribution of returns. This allows us to demonstrate pictorially the return patterns associated with short volatility strategies. A review of these return patterns can provide some sense of the downside risk of loss. Using the mimicking portfolios we run 10,000 simulations for both merger arbitrage and event driven hedge fund strategies. The results are presented in Figure 6.

Briefly, the one-month VAR for event-driven hedge fund strategies is −2.51% at a 1% confidence level and −1.59% at a 5% confidence level. This means that we can state with a 99% (95%) level of confidence that the maximum loss sustained by an event-driven hedge fund manager will not exceed 2.51% (1.59%) in any given month. The one-month VAR for merger arbitrage strategies is −6.04% at the 1% confidence level and −3.14% at the 5% confidence level. Finally, the maximum loss for event-driven arbitrage is −4% compared to −10.74% for merger arbitrage.

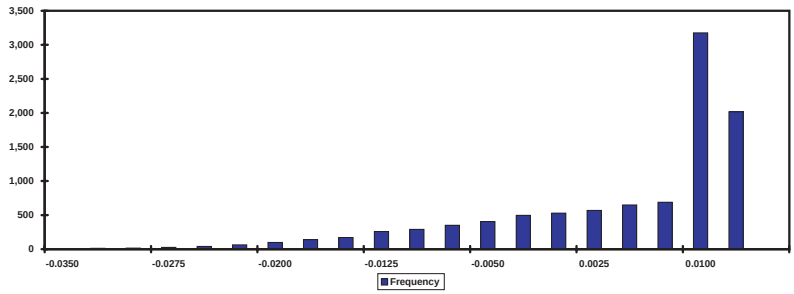
	Event Driven	Merger Arbitrage
One Month VaR @ 1% Confidence Level	-2.51%	-6.04%
One Month VaR @ 5% Confidence Level	-1.59%	-3.14%
Maximum Loss	-4.00%	-10.74%
Number of Simulations	10000	10000

Figure 6 One month Monte Carlo VAR for event-driven and merger arbitrage.

Figures 7 and 8 present the frequency distributions and associated statistics for event-driven and merger arbitrage returns based on our Monte Carlo simulations. Both distributions demonstrate a negative value of skewness and a large positive value of kurtosis leading to a large downside tail—the same risk exposure as a short put option.

Both event-driven and merger arbitrage strategies demonstrate large downside tails. We also note that

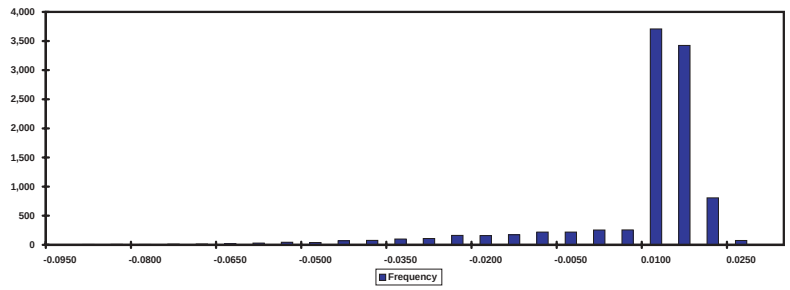
	Frequency
-0.0350	9
-0.0325	13
-0.0300	15
-0.0275	26
-0.0250	40
-0.0225	63
-0.0200	98
-0.0175	140
-0.0150	170
-0.0125	258
-0.0100	291
-0.0075	351
-0.0050	404
-0.0025	496
0.0000	528
0.0025	569
0.0050	648
0.0075	689
0.0100	3,175
0.0125	2,016
More	0



Series:	EVENT
Observations	10,000
Mean	0.003141
Median	0.008275
Maximum	0.010174
Minimum	-0.039991
Std. Dev.	0.009150
Skewness	-1.392228
Kurtosis	4.301877
Jarque-Bera	3936.699
Probability	0.000000

Figure 7 Distribution of returns for event-driven.

	Frequency
-0.0950	4
-0.0900	7
-0.0850	9
-0.0800	7
-0.0750	12
-0.0700	15
-0.0650	19
-0.0600	30
-0.0550	44
-0.0500	40
-0.0450	70
-0.0400	77
-0.0350	99
-0.0300	108
-0.0250	162
-0.0200	159
-0.0150	172
-0.0100	219
-0.0050	220
0.0000	255
0.0050	256
0.0100	3,708
0.0150	3,425
0.0200	807
0.0250	75
More	0



Series:	MERGER
Observations	10,000
Mean	0.004513
Median	0.009276
Maximum	0.024448
Minimum	-0.107392
Std. Dev.	0.015771
Skewness	-2.764972
Kurtosis	11.543930
Jarque-Bera	43157.900
Probability	0.000000

Figure 8 Distribution of returns for merger arbitrage.

the downside tail is greater for merger arbitrage. This is consistent with our VAR analysis and the fitted regression lines in Figure 3, and indicates a greater exposure to short volatility risk.

7 Risk management for short volatility strategies

The analysis we presented above demonstrates a short volatility exposure associated with merger arbitrage. We now address whether this exposure can be hedged. One solution would be to buy put options on the VIX index equivalent to the short volatility exposure embedded in event-driven and merger arbitrage strategies.

This is an active strategy that requires the rolling of put options to maintain a continuous hedge against merger arbitrage and event-driven strategies. In addition, the amount of put options to purchase will change as the delta of the short put option changes. This requires a form of dynamic hedging known as portfolio insurance. While portfolio insurance can be an effective tool, it has several weaknesses that were exposed during the market crash of October 1987. Most notably, "chasing deltas" as the market declines rapidly can lead to a downward spiral of stock prices from which it is difficult to recover.

An alternative to this active strategy is to invest in hedge fund strategies that tend to be long volatility. Prior empirical studies have indicated that managed futures, or commodity trading advisors, have investment strategies that tend to be long volatility. CTAs often pursue what are known as trend following strategies. That is, they try to capture the momentum of extended upside and downside price

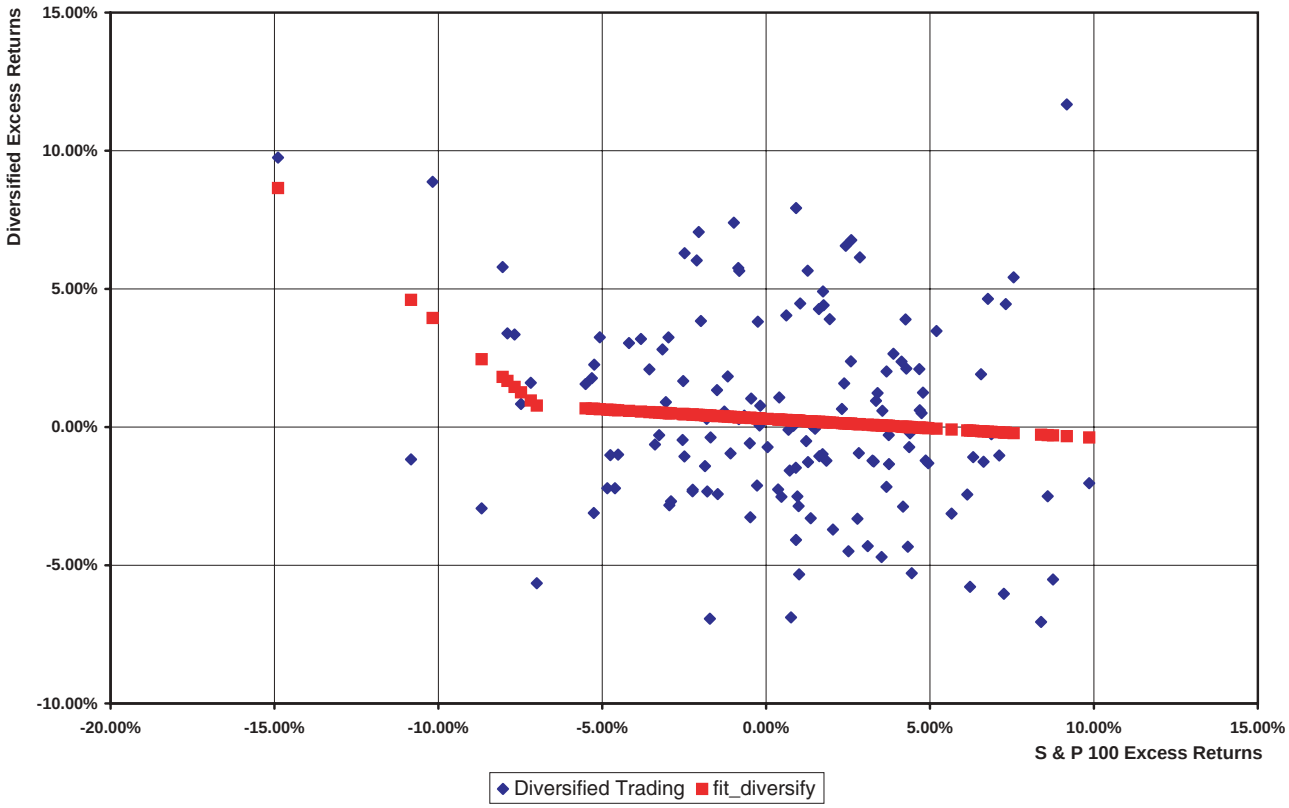


Figure 9 Diversified trading index.

movements. Fung and Hsieh (1997) found that trend following styles have a return profile similar to a long option straddle position—a long volatility position.

To examine this possibility, we use the Barclay's Diversified Commodity Trading Advisor Index. This is an equal weighted composite of managed futures programs that trade a diversified portfolio.[8] We proceed with the same analysis as for hedge fund managers. Figure 9 presents the scatter plot of managed futures versus the S&P 100 as well as the fitted regression line, and Figure 10 provides the regression statistics. Notice that α_{low} and β_{low} are economically and statistically significant.

	Coefficient	t-Statistic
Threshold	-0.0700	
Alpha low	-0.0619	-2.0456
Beta low	-0.9968	-2.5686
Alpha high	0.0030	
Beta high	-0.0685	-0.9015
S.E. Regression	0.0347	
R square	0.0667	
Adj R Square	0.0534	

Figure 10 Barclay's diversified trading advisor index.

Together, these two exhibits demonstrate a long put position—the mirror image of event-driven and merger arbitrage strategies. This analysis is reinforced by our mimicking portfolio (Figure 11) and our Monte Carlo simulation for VAR statistics (Figure 12). We note that the VAR statistics for managed futures is significantly less than that for event-driven or merger arbitrage trading strategies. This is consistent with a long put option position—being able to minimize losses in a market down-turn.

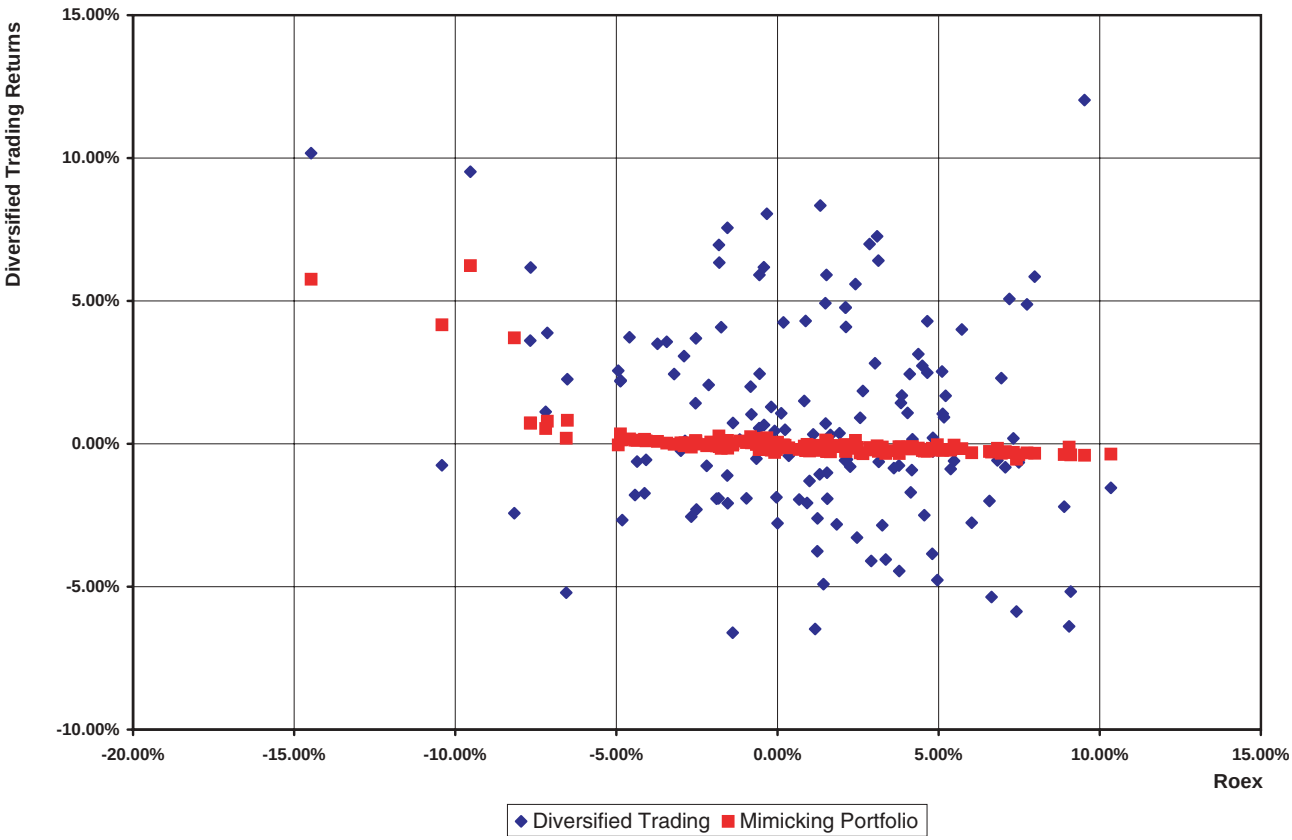


Figure 11 Diversified trading index and mimicking portfolio returns.

Finally, in Figure 13, we present the frequency distribution of managed futures returns as well as the related distributional statistics. We note that the diversified managed futures index has a large positive value of skewness and a large positive value of kurtosis, indicating a "fat" positive tail. In sum, managed futures provide a distribution of returns that is a mirror image of that for event driven or merger arbitrage strategies. We conclude that managed futures are an excellent diversifying agent for a hedge fund program that includes event driven and merger arbitrage strategies (see Kat, 2002).

8 Conclusion

We demonstrate that event-driven and merger arbitrage hedge strategies replicate the sale of insurance contracts. The sale of insurance contracts is a short volatility investment strategy that can result in occasional large losses. Our analysis can be extended to other hedge fund strategies that follow similar economic dynamics. For example, Favre and Galeano (2002) describe relative value hedge fund strategies as selling economic disaster insurance. As a consequence, many hedge fund strategies use a short volatility strategy to increase their return.[9] A key issue is that short volatility strategies are often synthetic, off-balance sheet and not apparent from position transparency.

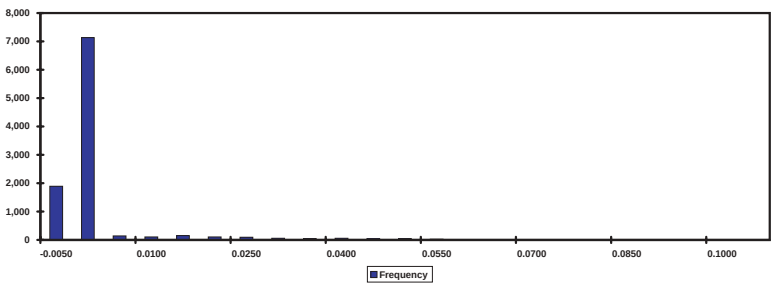
This will result in a reasonable return as long as the insurance (short put option) premiums continue to be collected. However, when a volatility event occurs, the results can be disastrous. Investors, in effect, "put" their losses to the hedge fund manager, resulting in large declines in value. This exposure, can be managed, however, through the use of managed futures or commodity trading advisors. These managers use trend following strategies that tend to be long volatility and can dampen the short volatility bias of certain hedge fund strategies.

As a final thought, in this paper, we demonstrated how merger arbitrage and event-driven strategies exhibit a short put option exposure based on the direction of the market. This was done to demonstrate that in positive stock markets, merger arbitrage and event driven strategies collect insurance premiums. However, in down markets, these "insurance policies" must be paid out resulting in large losses to these hedge fund strategies. The next step in the research would be to measure the profitability of these strategies relative to the volatility

One Month VaR @ 1% Confidence Level	-0.808%
One Month VaR @ 5% Confidence Level	-0.665%
Maximum Loss	-1.209%
Number of Simulations	10000

Figure 12 One month Monte Carlo VAR for diversified trading.

	Frequency
-0.0050	1,892
0.0000	7,134
0.0050	140
0.0100	105
0.0150	152
0.0200	106
0.0250	93
0.0300	59
0.0350	47
0.0400	59
0.0450	44
0.0500	47
0.0550	27
0.0600	16
0.0650	14
0.0700	12
0.0750	14
0.0800	10
0.0850	7
0.0900	8
0.0950	2
0.1000	7
More	4



Series:	DIVERSIFY
Observations	10,000
Mean	-0.000838
Median	-0.003264
Maximum	0.108456
Minimum	-0.012094
Std. Dev.	0.011022
Skewness	4.779558
Kurtosis	29.895650
Jarque-Bera	339480.300
Probability	0.000000

Figure 13 Distribution of returns for managed futrues.

implied in the VIX. Another issue to be resolved is whether the absolute level of returns expected for these strategies accounts for the short volatility exposure.

Notes

[1] This paper reflects the insights and opinions of the authors and not the authors' employer.

[2] As an aside, it is worthwhile to note that the payout for a short put option is equivalent to the payout for a covered call option.

[3] We acknowledge the helpful comments of an anonymous reviewer who clarified this point for us.

[4] We acknowledge that there are several data biases associated with hedge fund databases. However, our goal is not to measure the size of the returns, but rather the risk that they create. For a full discussion on hedge fund data biases, see Fung and Hsieh (2002).

[5] Excess return is simply the total return minus the current risk free rate.

[6] We found the threshold value through a recursive method, which finds the threshold value that minimizes the residual sum of squares in Eq. (3).

[7] There is no t statistic for α_{high} because this coefficient is solved as a function of the other regression coefficients (see Eq. (2)).

[8] We use this composite to insure that the managed futures programs are not concentrated toward the economics of any specific market. We also examined Barclay's Commodity Trading and Systematic Trading indices and found similar results.

[9] See Anson (2002a) or Weisman (2002).

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