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Skewing Your Diversification

Mark S. Shore
Alternative Investment Consultant
New York, New York
mshore@chicagogsb.edu

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Abstract

This paper reviews the performance metrics and use of alternative asset allocations within a traditional asset portfolio. We show most asset classes are not Gaussian (bell-shaped) normal curves as modern portfolio theory assumes returns to be. Instead, the returns are asymmetrical to the right or left causing the employment of higher statistical moments such as skewness and kurtosis to determine risk-adjusted returns. Therefore, the first and second statistical moments (mean and variance) are not sufficient to determine risk-adjusted returns of a portfolio. Utilizing higher moments in conjunction with volatility parsed between upside and downside returns, we demonstrate how managed futures and hedge funds perform individually and simultaneously as diversifiers in a traditional portfolio.

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Skewing Your Diversification

As the realization of asset allocation has found itself in the vocabulary of many investors in recent years, it's interesting to view the upside return / downside return volatility (the standard deviation ratio or S-ratio), skewness, correlations, and returns in traditional portfolios when managed futures and hedge funds are introduced into the portfolio.

For years, investors would diversify their portfolios with the use of stocks, bonds and cash. Harry Markowitz's mean-variance work in the 1950s assisted the advancement of portfolio diversification. Darst (2003) points out in the 1930s asset allocation was defined as 60% bonds and 40% equity. Not surprising, as the average life span was shorter than today's and the depression was fresh in everybody's mind. By the 1960s, the U.S. economy was growing and the asset allocation model shifted towards 60% domestic equity, 30% bonds and 10% cash. By the 1990s, sophisticated investors were integrating absolute-return strategies such as hedge funds and managed futures into their portfolios.[1]

The objective of this study is to understand how managed futures and hedge funds affect a traditional portfolio when allocated individually and simultaneously. Schneeweis and Spurgin (2000) stress alternative investments are to be additions to traditional portfolios; therefore the independent returns of these investments are not as important as how they may benefit the overall portfolio as discussed later in the paper.[2]

The first and second statistical moments better known as mean and variance (standard deviation), are the conventional tools to determine the risk and return of an investment. The third and fourth moments, skewness and kurtosis have been receiving greater attention in recent years by academics and practitioners to more fully understand the risk-adjusted returns and the functionality of investment components within a portfolio to reduce volatility.

Skewness relates to the symmetrical characteristics of the return distribution. Returns shifted towards the right (left), create positive (negative) skewness causing asymmetrical returns. When considering components of a portfolio, one must consider the co-skewness of each component. What is the result of the portfolio's skewness when a new asset is introduced into the portfolio? Harvey and Siddique (2000) define co-skewness as "the component of an asset's skewness related to the market portfolio's skewness." Co-skewness may be utilized to reduce "volatility shocks" to the portfolio.[3] Table 2 demonstrates the advantage of skewness for portfolio diversifiers to reduce tail risk. Kurtosis describes the fatness of the tail by the peakedness or flatness of the distribution. The higher the excess kurtosis of the return distribution, the greater the peakedness of the distribution. Bacmann and Scholz (2003) describe a higher kurtosis as a greater probability for extreme returns.[4]

Positive skewness of returns infers the potential for greater variance of positive returns than negative returns; the ideal behavior of what an investor seeks in loss aversion of an investment. Kraus and Litzenberger (1976) empirical studies support a rational investor's

preference for positive skewness and reducing volatility.[5] As Till (2002) writes, the use of the mean-variance metric is most appropriate when an investment's return distribution is symmetrically distributed. If one uses this risk measure for asymmetrically distributed investments, one would have to assume that investors are indifferent between upside risk and downside risk.[6] To assume investors are indifferent between gains and losses contradicts the behavioral finance work of Kahneman and Tversky's (1979) prospect theory of loss aversion where investor's preference of losses carries more weight than similar gains on a utility curve.[7] This preference causes a greater investigation into the downside risk of a portfolio. By avoiding the third and fourth moments, investors may overlook how the components of a portfolio compliment or decay the long run effects of a portfolio.

If a return distribution is asymmetrical, an investor must consider if the investment is prone to greater variance of positive or negative returns. One could argue positive (negative) skewness is similar to long (short) optionality because the payoff structure is similar to buying (writing) options. Agarwal and Naik (2002) find many hedge fund strategies have negative skewness due to dynamic trading strategies creating payoff structures similar to writing puts, thus causing greater left tail risk.[8] Our study also found left tail risk in hedge funds as observed in table 1 from the negative skewness and high excess kurtosis. Managed futures is more prone to long optionality observed in the positive skewness (see table 1) and therefore less left tail risk. This is due in part to the tendency for CTAs to be trend-followers.

Sharpe (1994) states mean and variance statistics are good measurements for normal distribution. Analyzing non-normal return distributions with mean and variance metrics are not enough to fully comprehend the risk-adjusted returns.[9] As noted in table 1, most asset classes are not normally distributed. Some of the assumptions implied in the Sharpe ratio include:

- Historic results have at least some predictive ability.
- Mean and variance are sufficient statistics for evaluating a portfolio.
- Investments should have similar correlations in order to choose the highest Sharpe ratio. An investment with a smaller correlation to a portfolio (such as alternative investments) may add greater value with a smaller Sharpe ratio.
- The distribution is symmetrical. As many studies have pointed out, often time-series distributions are asymmetrical.

Kat (2002) found hedge funds and managed futures may compliment each other in a portfolio, but only when managed futures receives at least 45% to 50% of the alternative allocation.[*] For our study, we gave 10% allocation to alternative investments and an equal 5% allocation to managed futures and hedged funds when simultaneously allocated to a traditional portfolio. Kat used the following indices for his studies: S&P500 index, 10 year Salomon Brothers Government Bond index, a median equally weighted portfolio

[*] The statistical results of hedge funds and managed futures are based on industry representative indices. Results may vary with individual funds and/or trading strategies.

of 20 hedge funds and the Stark 300 index to benchmark managed futures. His test period ran from June 1994 to May 2001.[10]

To test for benchmark robustness this study utilized the following indices: S&P500, Citigroup Corporate Bond Index (formerly Salomon Corporate Bond Index), HFR Fund of Fund Index, and the CISDM Public Fund Index (formerly Zurich Public Fund Index). Replacing the S&P 500 with other stock indices found similar test results concluding benchmark robustness. Utilizing data from January 1990 to December 2004 found the existence of temporal robustness.

Five portfolios comprised the various asset allocations:

1) Stocks 100%.
2) Stocks 60% and bonds 40%.
3) Stocks 60%, bonds, 30%, hedge funds 10%.
4) Stocks 60%, bonds 30%, managed futures 10%.
5) Stocks 60%, bonds 30%, 5% hedge funds and 5% managed futures.

The 10% allocation to alternative assets in portfolios #3, #4 and #5 permits greater potential for non-correlation of the portfolio components as noted in table 3. The study tested each portfolio, not so much for the returns, but more importantly, to examine the results of positive/ negative volatility and skewness of the portfolio when hedge funds and managed futures are introduced into the asset allocation. Portfolio #3 and #4 also test for efficiency of allocation.* The results in table 2 demonstrate managed futures to have greater efficiency of allocation than hedge funds.

Brooks & Kat (2001) testing of various hedge funds indices concluded the return distributions to be asymmetrical or non-normal because of negative skewness and positive excess kurtosis, causing an overstatement of risk-adjusted returns based on the Sharpe ratio. Their study concluded a high correlation of hedge fund indices to the stock market.[11] Our study also found hedge funds to be asymmetrical distributions with negative skewness and high excess kurtosis; a high correlation of hedge funds to equity indices and a non-correlation of managed futures to equities as noted in table 3. This may not be surprising when Till (2003) illustrates 60% of hedge funds in the HFR universe are equity-based strategies.[12]

* This study defines allocation efficiency as improved portfolio skewness and reduced downside risk obtained from adding an investment.

January 1990 to December 2004:

Extending the data by eight years relative to Kat (2002) and utilizing different benchmarks, the results of the two studies were similar.

Table 1: Contains statistics of each index for 14 years from Jan. 1990 to Dec. 2004.

	S&P500	Citigroup	DJ	Nasdaq	HFR	CISDM	Barclay	EAFE
Monthly Avg Return	0.96%	0.69%	0.85%	1.22%	0.82%	0.57%	0.59%	0.49%
Monthly Standard Dev	4.23%	1.36%	4.27%	7.40%	1.62%	3.74%	2.63%	4.84%
Annual Return	11.53%	8.25%	10.24%	14.59%	9.84%	6.82%	7.10%	5.82%
Annual StdDev	14.67%	4.72%	14.78%	25.63%	5.62%	12.97%	9.13%	16.76%
Total Returns	376.60%	237.57%	291.81%	437.51%	324.87%	145.13%	172.13%	93.79%
Skew	-0.47	-0.36	-0.53	-0.41	-0.26	0.47	0.38	-0.19
Kurtosis	0.64	0.92	1.01	0.93	4.35	1.05	0.38	0.41
Monthly Max	11.40%	4.70%	10.60%	22.00%	6.85%	15.72%	10.03%	15.60%
Monthly Min	-14.50%	-4.42%	-15.13%	-22.80%	-7.47%	-9.60%	-5.49%	-13.90%
Info Ratio	0.79	1.75	0.69	0.57	1.75	0.53	0.78	0.35
Sharpe Ratio	0.45	0.69	0.35	0.37	0.86	0.14	0.23	0.05
Avg + Months	3.49%	1.33%	3.40%	5.65%	1.49%	3.22%	2.44%	3.63%
Avg - Months	-3.46%	-1.05%	-3.35%	-5.93%	-1.03%	-2.53%	-1.67%	-4.18%
StdDev + Months	2.46%	0.89%	2.51%	4.48%	1.18%	2.75%	1.89%	2.91%
StdDev - Months	2.86%	0.88%	3.08%	5.27%	1.21%	1.92%	1.32%	3.07%
S-Ratio	0.86	1.01	0.81	0.85	0.97	1.43	1.43	0.95

Data Source: CISDM Public Fund Index (Formerly Zurich and Mar Public Fund Index) Managed Accounts Reports, LLC, New York, NY. S&P 500 Index, Citigroup Corporate Bond Index (formerly, Salomon Corporate Bond Index), NASDAQ Composite Index, Dow Jones Industrial Average Index and MSCI EAFE Index are provided by Strategic Financial Solutions, LLC, Memphis, TN. Barclay CTA Index provided by Barclay Trading Group, Fairfield, IA. HFR Fund of Fund Index provided by HFR Asset Management, Chicago, IL.

The indices above cover domestic and international equities, bonds, hedge funds and managed futures. Only the CISDM Public Fund Index and the Barclay CTA index (both representing the managed futures industry) result in positive skewness[*]. The annualized standard deviation of the alternative asset indices is lower than the equity indices. However, one has to look to the S-ratio for a better sense of risk-adjustment to determine if the volatility is derived more from the positive or the negative monthly returns. The S-ratio above 1 implies positive months are deriving greater volatility than negative months. If an investment has greater dispersion of positive returns than of negative returns it should be logical for the skewness of the returns to support this theory and ultimately add value to a portfolio. In fact, the skewness results in table 1 support this theory. On a risk-adjusted basis determined by the S-ratio, the indices are ranked: CISDM and Barclay, Citigroup, HFR, EAFE, S&P 500, NASDAQ, and Dow Jones.

[*] The Barclay CTA Index, the CISDM Public Fund Index and the HFR Fund of Fund Index are calculated net of expenses. The Barclay CTA Index data supports the benchmark robustness of the study.

The Dow Jones Industrial Index, NASDAQ Composite Index, Barclay CTA Index and MSCI EAFE are listed above for comparison purposes.

Sharpe ratio risk-free rate = 5%.

Table 2: Contains the statistics of the five portfolios from Jan. 1990 to Dec. 2004.

	Port #1	Port #2	Port #3	Port #4	Port #5
	S&P500	S&B	S,B,HFR	S,B, & CISDM	S,B, HFR & CISDM
Monthly Avg Return	0.96%	0.85%	0.86%	0.84%	0.85%
Monthly Standard Dev	4.23%	2.73%	2.75%	2.67%	2.70%
Annual Return	11.53%	10.22%	10.38%	10.08%	10.23%
Annual StdDev	14.67%	9.45%	9.51%	9.26%	9.36%
Total Returns	376.60%	330.72%	340.59%	322.83%	331.76%
Skew	-0.47	-0.39	-0.47	-0.24	-0.36
Kurtosis	0.64	0.38	0.62	0.34	0.45
Monthly Max	11.40%	8.08%	8.22%	9.34%	8.78%
Monthly Min	-14.50%	-8.62%	-9.39%	-7.86%	-8.62%
Info Ratio	0.79	1.08	1.09	1.09	1.09
Sharpe Ratio	0.45	0.55	0.57	0.55	0.56
Avg + Months	3.49%	2.40%	2.40%	2.29%	2.36%
Avg - Months	-3.46%	-2.17%	-2.20%	-2.22%	-2.17%
StdDev + Months	2.46%	1.62%	1.62%	1.66%	1.63%
StdDev - Months	2.86%	1.74%	1.81%	1.58%	1.70%
S-Ratio	0.86	0.93	0.89	1.05	0.96

Notice the average monthly returns and total returns are similar across the four combined portfolios. When 40% of the portfolio allocation in portfolio #2 is given to bonds, the annual standard deviation and annual returns are reduced by 36% and 11% respectively relative to portfolio #1, decreasing the volatility more than the returns. Skewness and kurtosis also show improvement. The reduction of volatility is seen in the reduced dispersion between the monthly maximum and minimum returns, the average positive and negative months, standard deviation of the positive and negative months and the S-ratio. Although the S-ratio is still below one, it did improve. As mentioned earlier the S-ratio improved with the skewness, proving a positive relationship between skewness and the S-ratio as both metrics are measuring the variance of the positive and negative monthly returns.

The skewness of the HFR index at -0.26 is an improvement over the skewness of portfolio #2 of -0.39. The result of allocating 10% to hedge funds diminishes the skewness of portfolio #3 to -0.47. This reduction of skewness is coupled with the very high 4.35 excess kurtosis of hedge funds causing the kurtosis of portfolio #3 to increase from 0.38 to 0.62. A portfolio of decaying skewness and higher kurtosis is not an investor's ideal scenario as it may increase tail risk. The standard deviation marginally increases from 9.45% to 9.51%, but you have to ask where the change in standard deviation originates. The S-ratio finds the negative returns increase volatility while the volatility of positive returns remains stable from portfolio #2 to #3. This is supported by the slight decay of the average down month in portfolio #3 from #2, while the average up month remained constant.

On the flipside, the CISDM index has a skewness of 0.47 and a kurtosis of 1.05. When 10% allocation is given to the CISDM index the skewness of portfolio #4 improves to -0.24 from -0.47. The S-ratio increases above 1 as the positive volatility increases and the negative volatility decreases. The monthly maximum return increases from 8.22% to 9.34% and the monthly minimum return improves from -9.39% to -7.86%. CISDM has a relatively low Sharpe ratio and yet it improves the portfolio's risk-adjusted returns. Sharpe (1994) pointed out, an investment with a low Sharpe ratio and low correlation to the portfolio may be a good diversifier for the portfolio. The improvement of the risk/return metrics demonstrates the addition of non-correlated assets to a highly concentrated portfolio has the potential to reduce downside volatility more than it reduces returns. The results of this are seen in table 2.

Table 3: Contains the correlations of each benchmark from 1/90 to 12/04.

	S&P500	Citi	DJ	NASDAQ	HFR	CISDM	Barclay	EAFE
S&P500	1	0.25	0.93	0.80	0.43	-0.12	-0.16	0.65
Citi		1	0.18	0.14	0.19	0.27	0.18	0.14
DJ			1	0.67	0.39	-0.13	-0.17	0.64
NASDAQ				1	0.53	-0.19	-0.21	0.55
HFR					1	0.17	0.23	0.37
CISDM						1	0.92	-0.07
Barclay							1	-0.12
EAFE								1

Table 3 illustrates the correlations of alternative investments to traditional investments. For example, the HFR Fund of Fund index possesses correlations of 0.43, 0.39, 0.53 and 0.37 to the S&P500, Dow Jones Industrial, NASDAQ and MSCI's EAFE index respectively. CISDM's correlations to these benchmarks are -0.12, -0.13, -0.19 and -0.07. These results point out an overall stronger positive correlation of hedge funds to equities than managed futures.[*]

Seeking assets to insert into a portfolio based on correlations are best analyzed when in conjunction with other metrics to determine the net effect of the portfolio, thus bringing us back to the use of higher moments.

[*]From January 1990 to Dec 1999, the correlation of the HFR index to the S&P 500 was 0.42, while the S&P 500 index to the CISDM index was 0.01. Demonstrating managed futures became more negatively correlated to the S&P 500 index since 2000.

On a four-year rolling basis, skewness of each index has varied, however the S&P500 and HFR index spent a considerable amount of time over the fourteen years with negative skewness. Interestingly, the negative skewness of the HFR index and the S&P500 index occur at similar moments, found in charts 2 and 3. The CISDM index also contains varying skewness, but only recently reached negative terms during these fourteen years, supporting the argument for managed futures as a more efficient product diversifier for a traditional portfolio.

Chart 1: Four-year rolling skewness of the CISDM Public Fund Index from 1/90 to 12/04

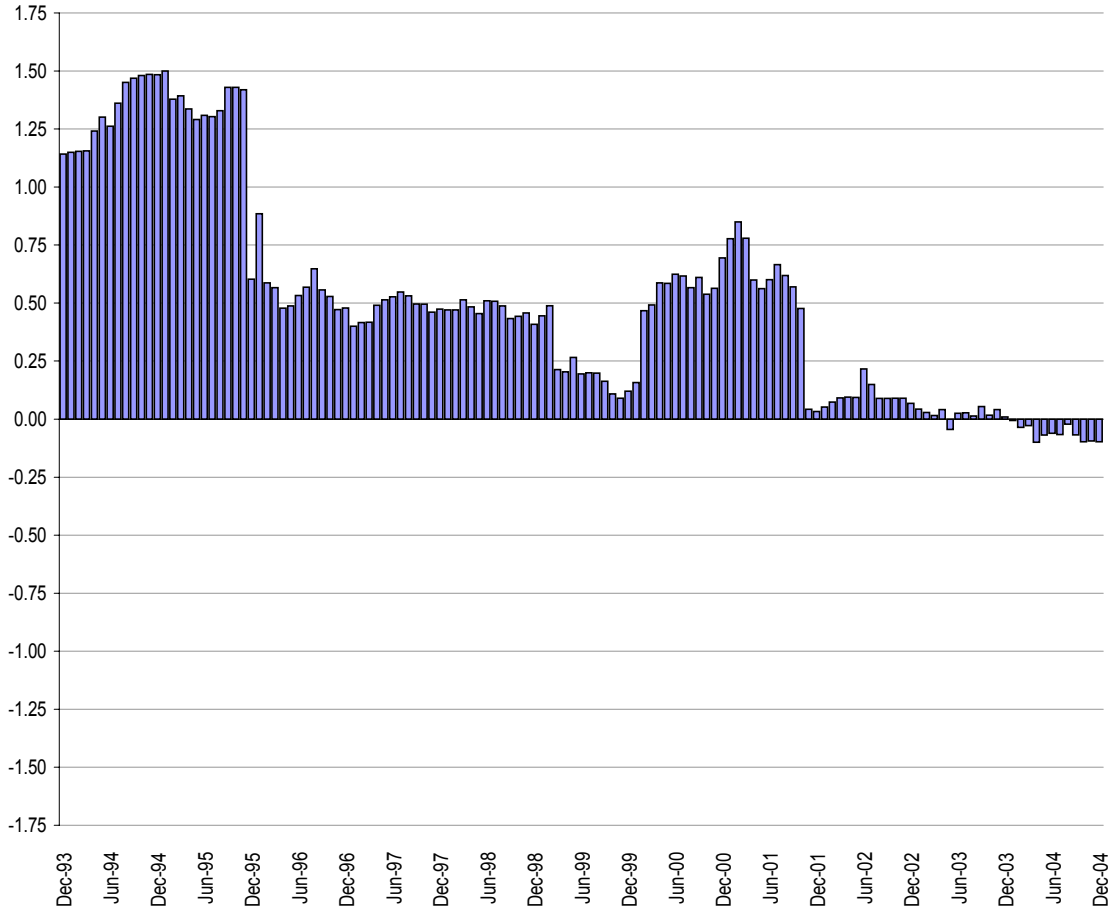

Chart 2: Four-year rolling skewness of the HFR fund of fund index from 1/90 to 12/04

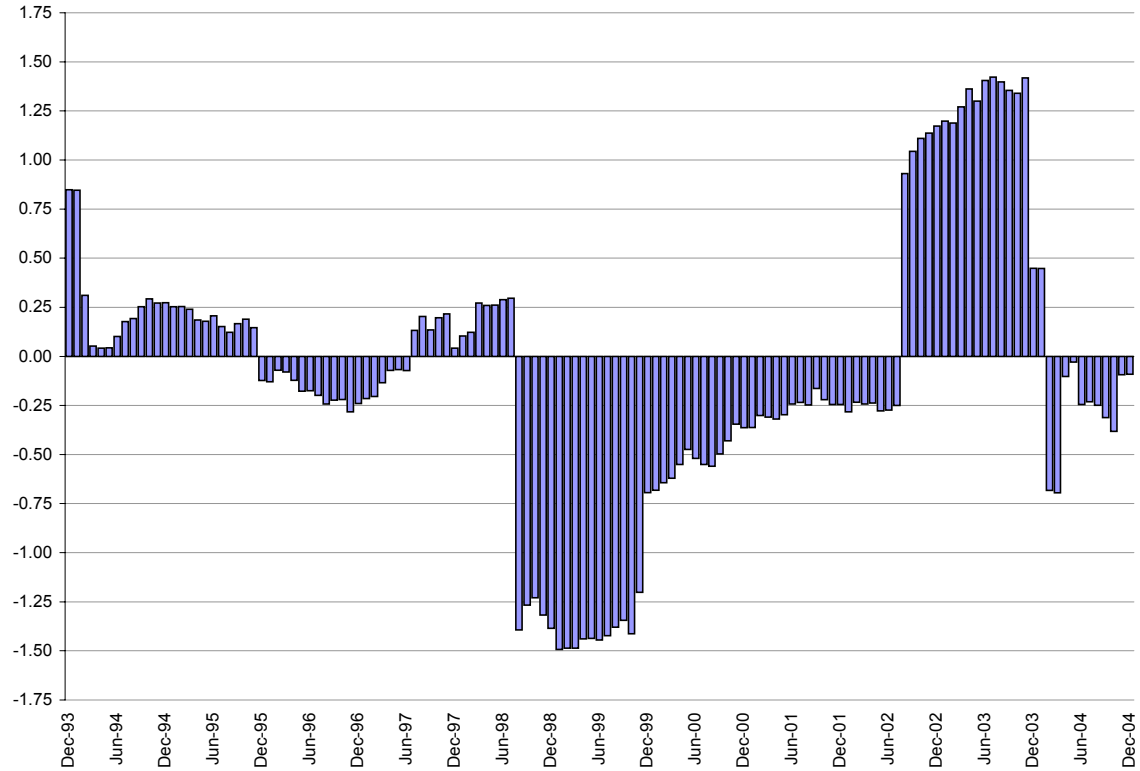

Chart 3: Four Year rolling skewness of the S&P500 Index from 1/90 to 12/04

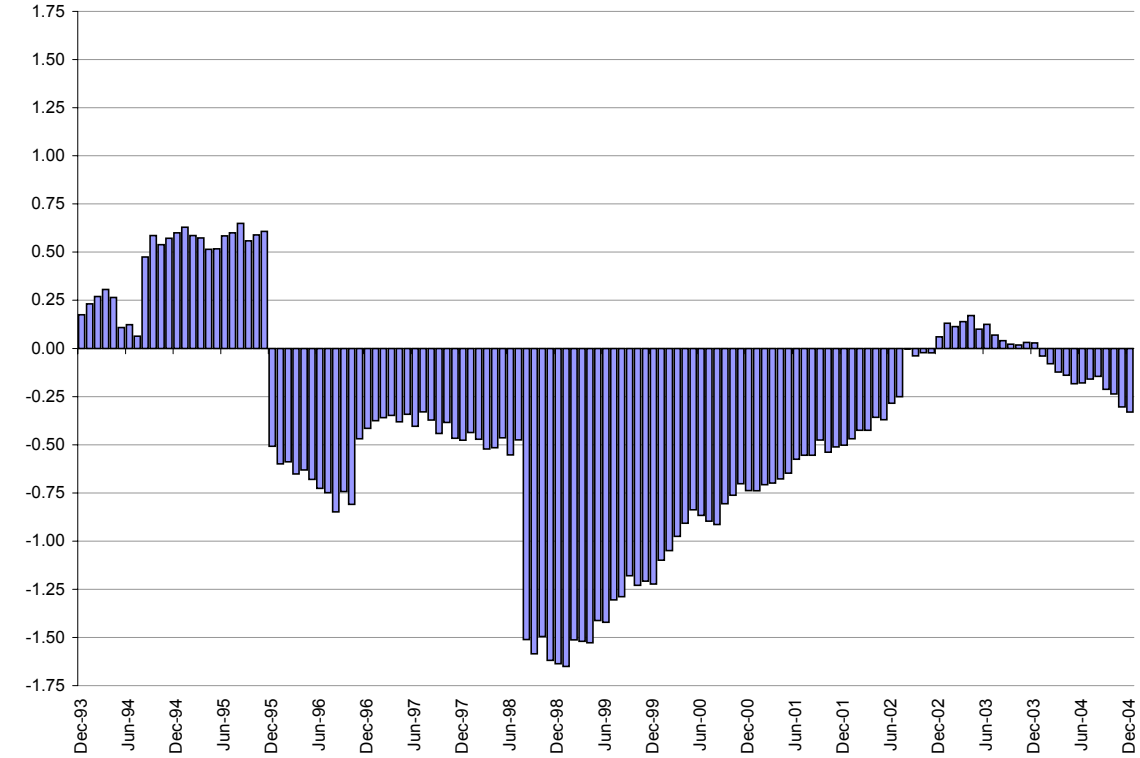

Chart 4: Mean Annual Return to Skewness of Benchmarks and Portfolios 1/90 to 12/04

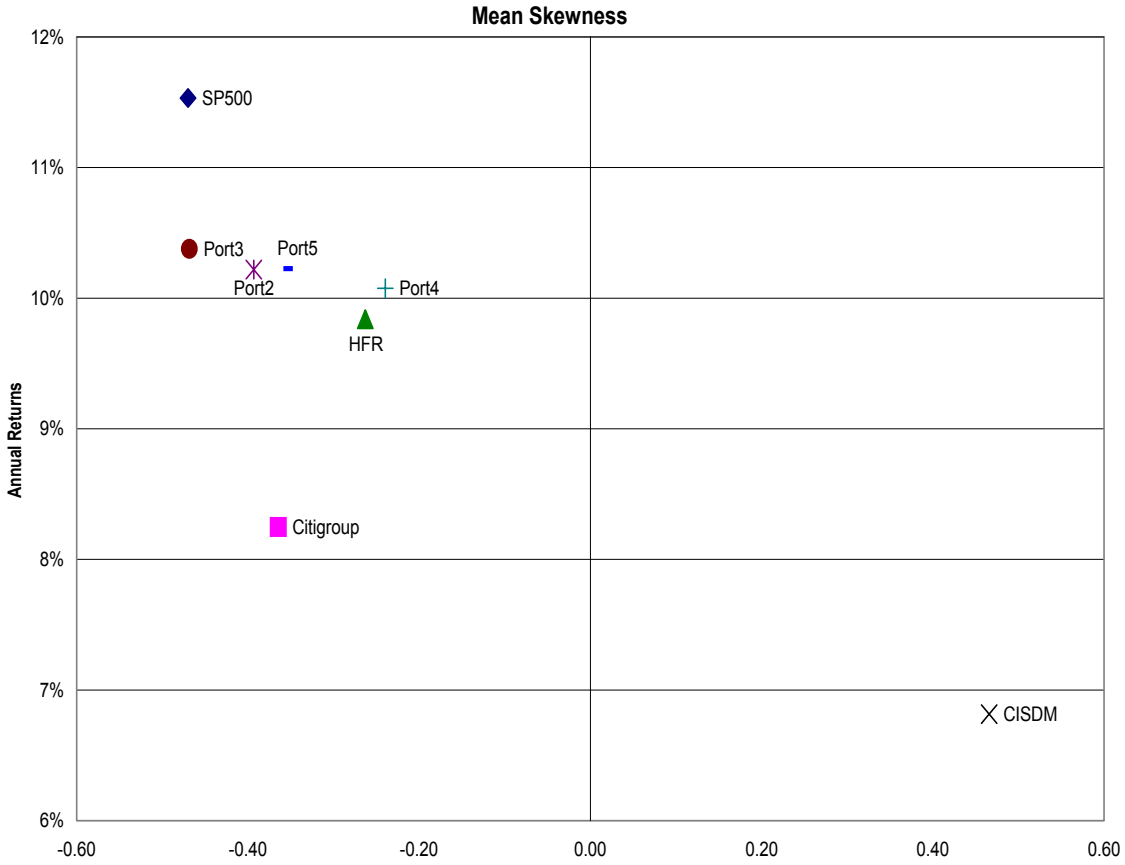

Chart 4 supports the argument of adding positively skewed investments to a naturally negatively skewed portfolio. You will notice the benchmarks and portfolios are clustered in the northwest corner of the chart with the exception of the CISDM benchmark. There is modest dispersion of returns among the portfolios. As noted earlier, portfolio #3 introduces hedge funds to a stock and bond portfolio and creates greater negative skewness and increased volatility. Portfolio #4 introduces managed futures into a stock and bond portfolio causing an improvement in skewness and volatility.

Note the location of portfolio #2 (a stock and bond portfolio) in chart 4. Allocating to either managed futures (portfolio #4) or an equal allocation of managed futures and hedge funds (portfolios #5) improves the skewness of not allocating to any alternative investments.

Chart 5: Mean Annual Return to Semi-Deviation Frontier from 1/90 to 12/04

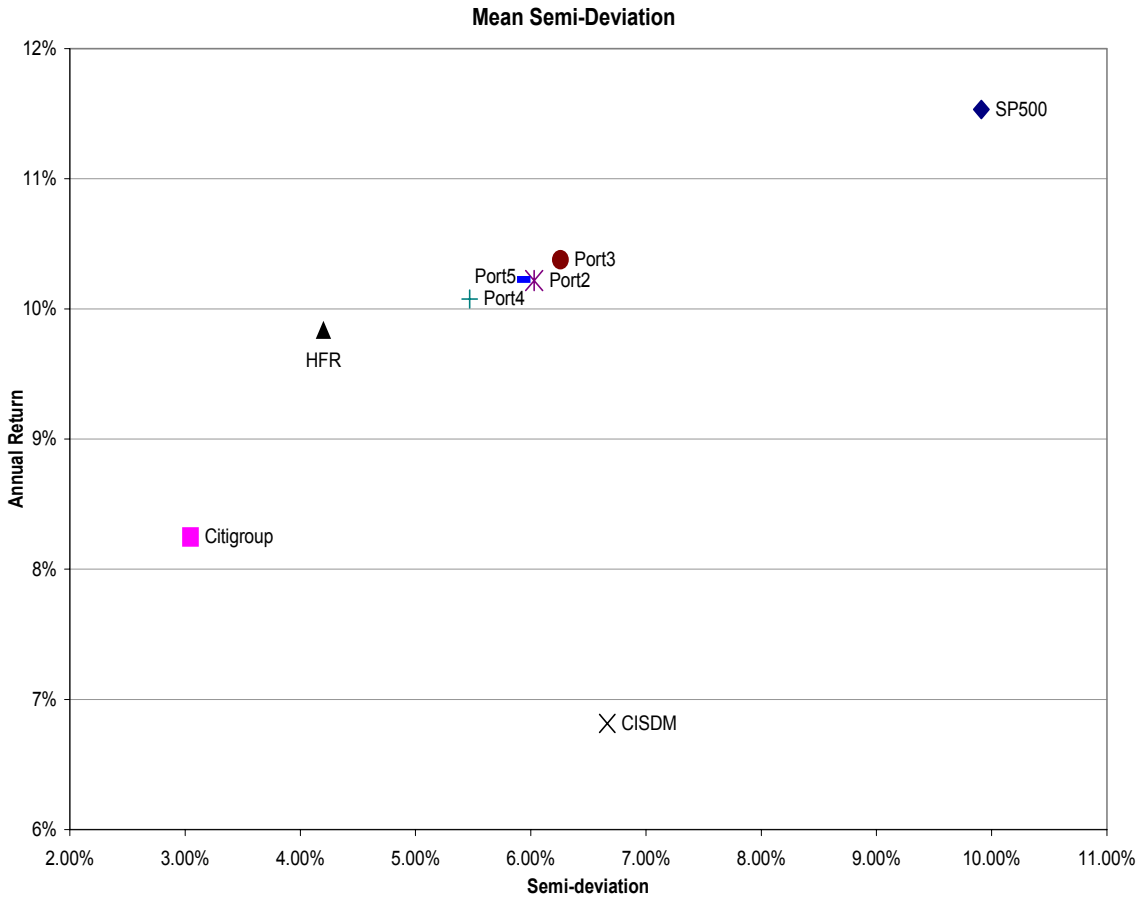

Chart 5 illustrates the annual average returns versus the negative standard deviation for each benchmark and portfolio. The conclusion is the same as found in chart 4. The allocation to managed futures or managed futures with hedge funds improves the risk-adjusted returns (portfolio #4 & #5) versus stocks and bonds as found in portfolios #1 and #2.

The portfolio returns are once again clustered with less downside risk found in portfolio #4. One must also keep in mind the relatively high correlation of hedge funds to equities.

CONCLUSION

1) The Sharpe ratio may overestimate the risk-adjusted returns by de-emphasizing the downside volatility of investments containing negative skewness. The Sharpe ratio may also understate the risk-adjusted returns of investments containing positive skewness by penalizing positive volatility. You have to know where the volatility originates from to understand the risk-adjusted returns.

2) Managed Futures has a reputation for high volatility, however when the positive and negative returns are parsed, greater volatility is found in the positive returns than in the negative returns leading to positive skewness. Proving the potential of managed futures as an efficient allocation to add value to a traditional portfolio to reduce downside risk. The S-ratio is an appropriate metric for this analysis.

3) If the correlations of investments are low and the monthly returns are asymmetrical, higher statistical moments are utilized for the co-skewness and downside risk effect to the portfolio.

4) Even though managed futures demonstrates greater efficiency than hedge funds due to the skewness and risk-adjusted returns, both may play a pivotal role in a traditional portfolio as seen in portfolio #5. Hedge funds encompass greater S-ratio volatility, negative skewness (short optionality), but may enhance the returns of a traditional portfolio when allocated properly with managed futures.

5) Expanding the duration of the study and utilizing different benchmarks relative to the Kat study, we found similar results proving temporal and benchmark robustness.

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