

How the VIX Ate my Kurtosis

- Alternative Title
 - Improving Hedge Fund Risk Exposures by Hedging Equity Market Volatility
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What is VIX?

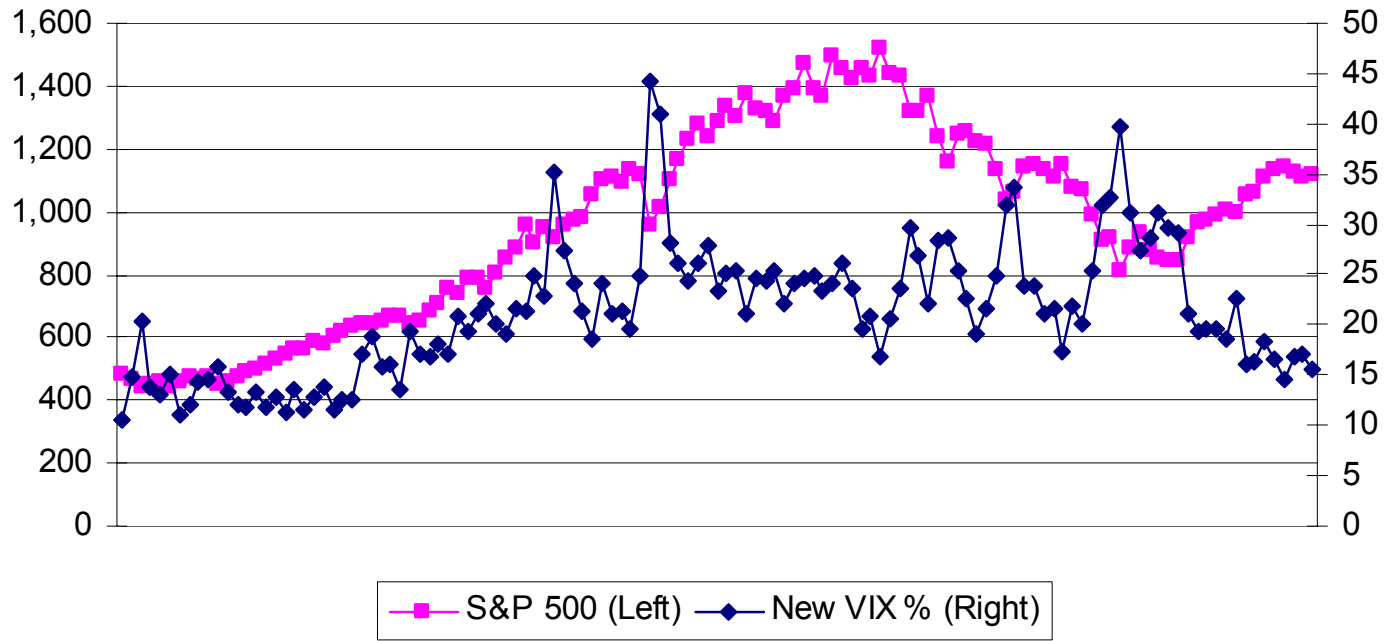
- CBOE volatility index measures implied volatility of 30 day S&P 500 options
- Measures fear or complacency in market
- Study uses the cash value of the new VIX
- CFE VIX Futures prices are different than cash VIX
- Cash VIX seems mean reverting
 - Range 9.94 to 45.74, Median 20.20
 - Middle 50% of days: 16.49 to 24.97
 - Frequent spikes. Buy below 16, sell above 25?

Mean/Variance Analysis

- Maximum Sharpe ratio is on efficient frontier
- Max return for each risk, or min risk for each return
- All mean/variance analysis (and Sharpe ratio) assumes that returns are normally distributed. Kurtosis=Skewness=0
- Inappropriate to use optimization and Sharpe ratio when returns are not normally distributed
- Key statistic: Cash VIX monthly change -63% correlation to SPX, -35% to -45% vs. hedge fund styles

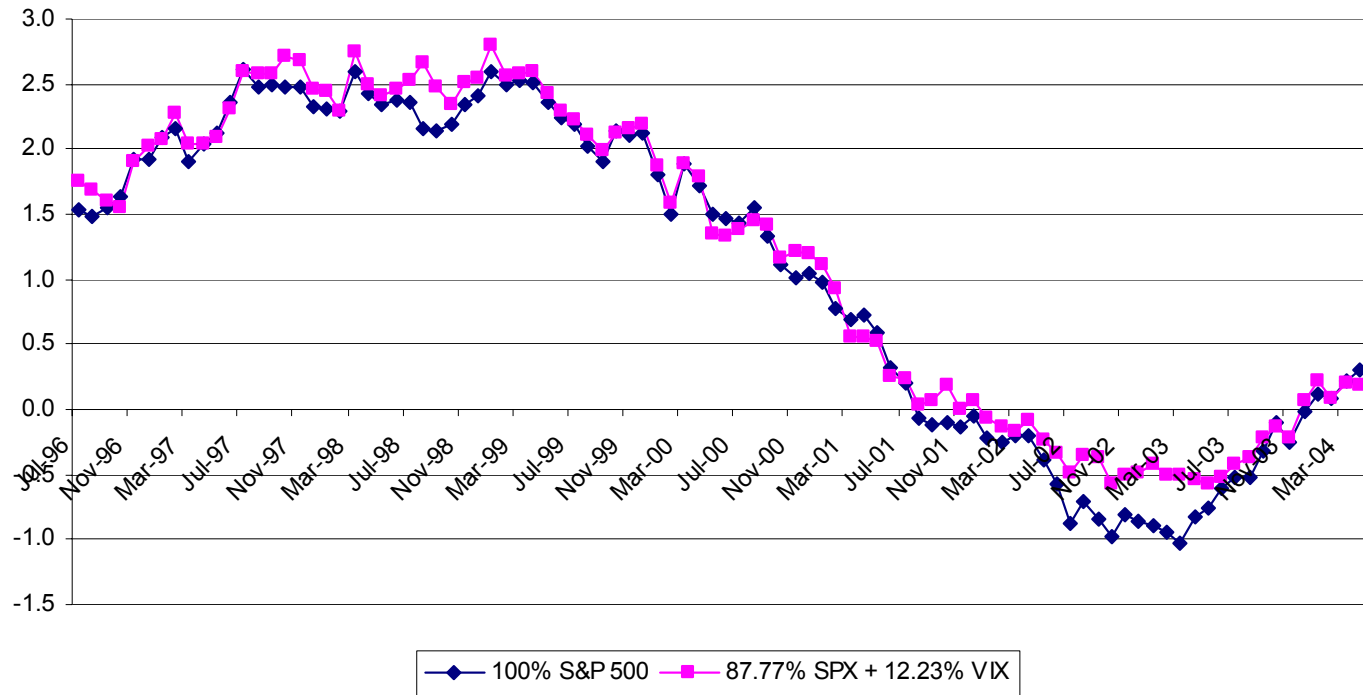
VIX vs. SPX since 1994

**Exhibit 1:
CBOE Volatility Index (VIX) vs. S&P 500 (1994-2004)**



SPX + VIX Hedge

Exhibit 3: VIX reduces volatility of an S&P 500 Portfolio
Average Monthly Return, Trailing 30 months



What are Hedge Funds?

- Hedge funds can be any style of unregistered, private placements
- Many designed for absolute returns
 - Higher % winning months than traditional investments
 - Lower standard deviation than equity indices

How are Hedge Funds Sold?

- Most hedge funds are sold by Sharpe ratio
 - Look at higher return, lower standard deviation
- Many hedge funds take significant event risk and liquidity risks, correlated with equity volatility
 - Less risky on normal market days
 - Much more risky on disastrous market days
 - Event and liquidity risks seen in skewness and kurtosis
- Brooks and Kat [2002]
 - High Sharpe ratio is not valuable if it comes at a cost of negative skewness and positive kurtosis

Can We Trust Hedge Fund Sharpe Ratios?

Exhibit 2

100% investment in each style portfolio

January 1994 to April 2004

	Annual Return	Standard Deviation	Sharpe Ratio	Downside Deviation	Sortino Ratio	Kurtosis	Skewness	Correlation to VIX	Correlation to Unhedged S&P 500
VIX	23.50%	61.82%	0.314	0.284	0.684	2.648	1.043		
S&P 500	12.05%	15.63%	0.509	0.090	0.886	0.408	-0.618	-0.635	
CSFB/Tremont Hedge Fund Index	11.41%	8.36%	0.875	0.041	1.804	2.089	0.134	-0.363	0.476
Convertible Arbitrage	10.53%	4.71%	1.367	0.027	2.353	4.381	-1.632	-0.067	0.126
Dedicated Short Bias	-1.56%	17.80%	-0.318	0.092	-0.615	2.314	0.952	0.552	-0.757
Emerging Markets	8.77%	17.53%	0.267	0.106	0.441	4.111	-0.654	-0.363	0.480
Equity Market Neutral	10.46%	3.06%	2.082	0.008	8.140	0.306	0.213	-0.184	0.399
Event Driven	11.65%	5.95%	1.268	0.040	1.867	24.934	-3.672	-0.448	0.552
Distressed	13.70%	6.89%	1.394	0.044	2.184	17.692	-2.922	-0.450	0.545
Event Driven Multi-Strategy	10.58%	6.27%	1.034	0.041	1.572	17.953	-2.809	-0.380	0.475
Risk Arbitrage	8.40%	4.40%	0.977	0.025	1.751	6.389	-1.339	-0.349	0.437
Fixed Income Arbitrage	6.96%	3.91%	0.731	0.028	1.034	19.730	-3.549	-0.014	0.029
Global Macro	15.20%	11.92%	0.931	0.061	1.823	2.405	-0.027	-0.191	0.232
Long/Short Equity	12.66%	10.86%	0.789	0.053	1.614	3.643	0.214	-0.395	0.583
Managed Futures	7.66%	12.31%	0.290	0.065	0.545	0.415	0.030	0.197	-0.210
Average Hedge Fund Style	9.73%	8.77%	0.899	0.049	1.886	8.182	-1.159	-0.189	0.259

The Cost of Options Hedging

- Kat [2003] proposes the purchase of OTM puts to hedge risks of higher moments
- Long puts have large standard deviation, positive skewness and kurtosis
- Cost to hedge stocks and hedge funds: 0.5% per year
- Cost to hedge stocks, bonds and hedge funds: 2.2% per year
- Options have time decay: hedge can be expensive in quiet markets
- Options have delta risk: less effective when further OTM

The Cost of Futures Hedging

- Buy futures instead of SPX puts when the cost of the futures hedge is cheaper than the cost of the options hedge
- Futures have little or no time decay
- Futures have no delta risk, always 100% delta
- The cost of the futures hedge depends on the term structure of volatility
 - Higher cost when forward vol $>$ today's vol
 - Lower cost when forward vol $<$ today's vol

Problem of Skewness and Kurtosis

- Skewness measures the symmetry of returns
 - Normal = zero
 - Negative/Left: Higher probability of earning below average return
 - Positive/Right: Higher probability of earning above average return
- Kurtosis measures the probability of extreme observations
 - Normal = zero
 - Positive = fat tails, higher risk of extreme moves
 - Negative = thin tails, lower risk of extreme moves

Using VIX to Hedge Higher Moment Risks

Exhibit 4

87.77% investment in each style portfolio

12.23% hedged in cash, new VIX

January 1994 to April 2004

	Annual Return	Standard Deviation	Sharpe Ratio	Downside Deviation	Sortino Ratio	Kurtosis	Skewness	Correlation to SPX Unhedged
S&P 500	13.40%	10.66%	0.872	0.049	1.910	-0.466	-0.012	0.836
CSFB/Tremont Hedge Fund Index	12.83%	8.41%	1.039	0.039	2.227	1.673	0.000	-0.156
Convertible Arbitrage	12.05%	8.37%	0.950	0.041	1.933	1.237	-0.384	-0.511
Dedicated Short Bias	1.23%	20.78%	-0.138	0.098	-0.292	4.208	1.294	-0.801
Emerging Markets	10.48%	14.47%	0.441	0.082	0.777	2.018	-0.025	0.179
Equity Market Neutral	11.99%	7.54%	1.046	0.028	2.776	1.390	0.630	-0.494
Event Driven	13.04%	7.01%	1.276	0.029	3.130	0.400	0.101	-0.273
Distressed	14.86%	7.25%	1.484	0.027	3.978	0.146	0.153	-0.207
Event Driven Multi-Strategy	12.09%	7.47%	1.070	0.033	2.388	0.612	-0.009	-0.292
Risk Arbitrage	10.15%	7.19%	0.842	0.028	2.144	0.457	0.404	-0.432
Fixed Income Arbitrage	8.87%	8.26%	0.577	0.044	1.073	3.111	-0.426	-0.569
Global Macro	16.19%	11.68%	1.035	0.058	2.085	3.286	-0.284	-0.203
Long/Short Equity	13.94%	9.54%	1.031	0.038	2.606	1.713	0.685	0.079
Managed Futures	9.49%	14.35%	0.376	0.068	0.795	2.256	0.635	-0.493
Average Hedge Fund Style	11.32%	10.18%	0.848	0.047	1.971	1.731	0.213	-0.321

Effectiveness of Hedge Depends on HF Style

Exhibit 5

Change in style characteristics with a VIX hedge

(Table Two Minus Table One)

January 1994 to April 2004

Many styles see dramatic risk improvement with a VIX hedge

	Annual Return	Standard Deviation	Sharpe Ratio	Downside Deviation	Sortino Ratio	Kurtosis	Skewness	Correlation to SPX
CSFB/Tremont Hedge Fund Index	1.42%	0.04%	0.164	-0.001	0.423	-0.416	-0.134	-0.632
Dedicated Short Bias	2.79%	2.98%	0.180	0.006	0.323	1.894	0.342	-0.044
Emerging Markets	1.71%	-3.06%	0.175	-0.024	0.337	-2.093	0.629	-0.301
Event Driven	1.39%	1.05%	0.008	-0.012	1.263	-24.534	3.774	-0.825
Distressed	1.16%	0.36%	0.090	-0.017	1.793	-17.546	3.075	-0.752
Event Driven Multi-Strategy	1.51%	1.20%	0.035	-0.008	0.816	-17.342	2.800	-0.767
Risk Arbitrage	1.75%	2.79%	-0.135	0.004	0.393	-5.932	1.742	-0.869
Fixed Income Arbitrage	1.91%	4.35%	-0.154	0.017	0.039	-16.619	3.122	-0.598
Global Macro	0.99%	-0.24%	0.104	-0.003	0.261	0.881	-0.257	-0.435
Long/Short Equity	1.28%	-1.31%	0.242	-0.015	0.992	-1.929	0.471	-0.504
S&P 500	1.35%	-4.97%	0.363	-0.041	1.024	-0.874	0.606	-0.164
Average	1.57%	0.29%	0.097	-0.009	0.697	-7.683	1.470	-0.536

Some hedge fund styles do not have significant risk reduction with a VIX hedge.

	Annual Return	Standard Deviation	Sharpe Ratio	Downside Deviation	Sortino Ratio	Kurtosis	Skewness	Correlation to SPX
Convertible Arbitrage	1.52%	3.66%	-0.417	0.014	-0.420	-3.144	1.248	-0.637
Equity Market Neutral	1.52%	4.48%	-1.036	0.021	-5.363	1.084	0.417	-0.893
Managed Futures	1.83%	2.05%	0.086	0.003	0.249	1.841	0.605	-0.283

Implementation?

- Hedge with futures when cheaper than hedging with options
- Is the term structure of volatility upward sloping or downward sloping?
- Futures likely cheaper than options when future volatility \leq current volatility

Liquidity and Pricing

- One contract is $\$1000 * VIX \sim \$15,000$
- Open interest is nearly 9,000 contracts
- Open interest notional value $\sim \$125$ million
- $\$125$ million VIX hedges a $\$1$ billion dollar hedge fund portfolio

The Basis is Falling!

