

VOLATILITY AND ENHANCED RETURNS

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Meeting at

Chicago Board Options Exchange, 400 South LaSalle Street.

Thursday, March 25, 2004; 5:00 p.m. – 7:00 pm.

Volatility: A measure of what has been

Implied Volatility: An indication of what may be

Volatility Concepts

Historic Volatility: A measure of price changes over a period of time. The annualized standard deviation of daily returns. It is often referred to as “*Realized Volatility*”

Expected Volatility: A forecast, an estimate, a best guess of future volatility, used to price derivative instruments.

Historic Volatility

Volatility and Variance, in the case of stocks, is normally done by employing logarithmic price changes to determine the standard deviation.

$$\text{Price change } x_i = \ln (C_i / C_{i-1})$$

C_i = closing price for day i

Historic Volatility

	<u>Mar.</u>	<u>Feb.</u>	<u>Jan.</u>	<u>Dec.</u>	<u>Annual</u>
CSCO	28.81	48.08	21.38	27.63	32.71
IBM	16.37	14.52	21.14	12.98	20.81
AA	26.37	32.75	37.77	26.80	30.40

Option Pricing

Black-Scholes

$$C = SN(d_1) - Xe^{-rt} N(d_2)$$

S = Present value of underlying

X = Exercise (Striking) Price

r = Risk free rate of return

t = Time to expiration

σ = Volatility

$$d_1 = \{\ln(S/X) + [r + (1/2)\sigma^2]t\} / \sigma\sqrt{t}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

Option Pricing

Binomial Tree

In constructing a binomial tree, the magnitude of the price changes (up and down) are determined by the following formulas

$$u = e^{\sigma \sqrt{t/n}}$$

$$d = e^{-\sigma \sqrt{t/n}} = 1/u$$

* n = the number of segments by which we are dividing the time to expiration

Volatility Concepts

Implied Volatility : Inserting the market price of an option into the BSF and solving the equation for volatility (σ), we arrive at the volatility of the underlying that the market price is predicting for the life of the option we have chosen.

Implied Volatility

IBM @ 92.31 on 03/19/04

April (28 day) implied vols

<u>Strike</u>	<u>IV *</u>	Historic Vol. (3/19/03 – 3/19/04)
75 ---	37.52	20.81
80	31.02	
85	27.18	
90	24.33	
95	22.49	
100	22.02	
105	24.28	

*source IV: Microhedge⁹

Implied Volatility

AA @ 35.34 on 03/19/04

April (28 day) implied vol

<u>Strike</u>	<u>IV</u>	Historic Vol. (3/19/03 – 3/19/04)
30 ---	44.11	
32.5	37.31	30.40
35	32.79	
37.5	30.86	
40	30.00	

Implied Volatility

CSCO @ 23.06 on 03/19/04

April (28 day) implied vol

<u>Strike</u>	IV	Historic Vol. (3/19/03 – 3/19/04)
20	38.31	
22.5	33.98	32.71
25	33.45	
27.5	40.42	

Volatility Index

1993 – CBOE introduced “VIX” based on options traded on the OEX (S&P 100). A very limited number of series were used just those centered around the at the money options.

VIX quickly became accepted as an indicator of the level of “fear” in the market place, and a measure of the impact of economic, political, and human events.

2001 - VXN, based on Nasdaq-100 options is introduced.

Volatility Index

Sept. 2003 CBOE changes the methodology by which VIX and VXN are calculated. And begins basing the VIX on options on the S&P 500.

The new method uses a wider range of options providing a more accurate representation of the thirty day outlook for the overall market.

Volatility Index Futures

March 26th CBOE will introduce futures contracts based on the VIX. Symbol = VX

Underlying --- $VXB = VIX * 10$

Contract size --- $VXB * 100$

Settlement monthly --- 3rd Wed.

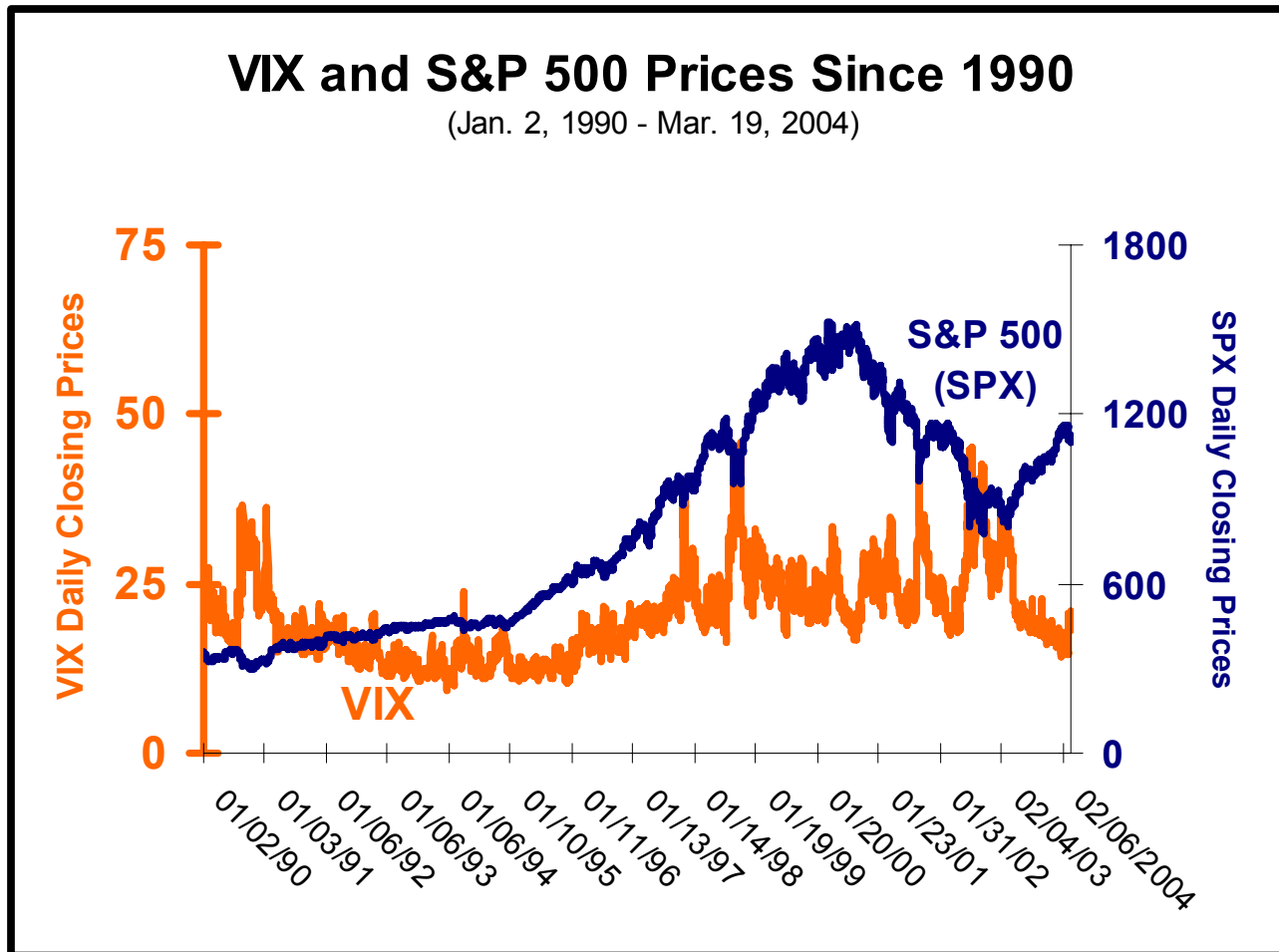
Contract months --- February quarterly cycle, plus nearest two months

Settlement value --- opening option prices on the 3rd Wed.

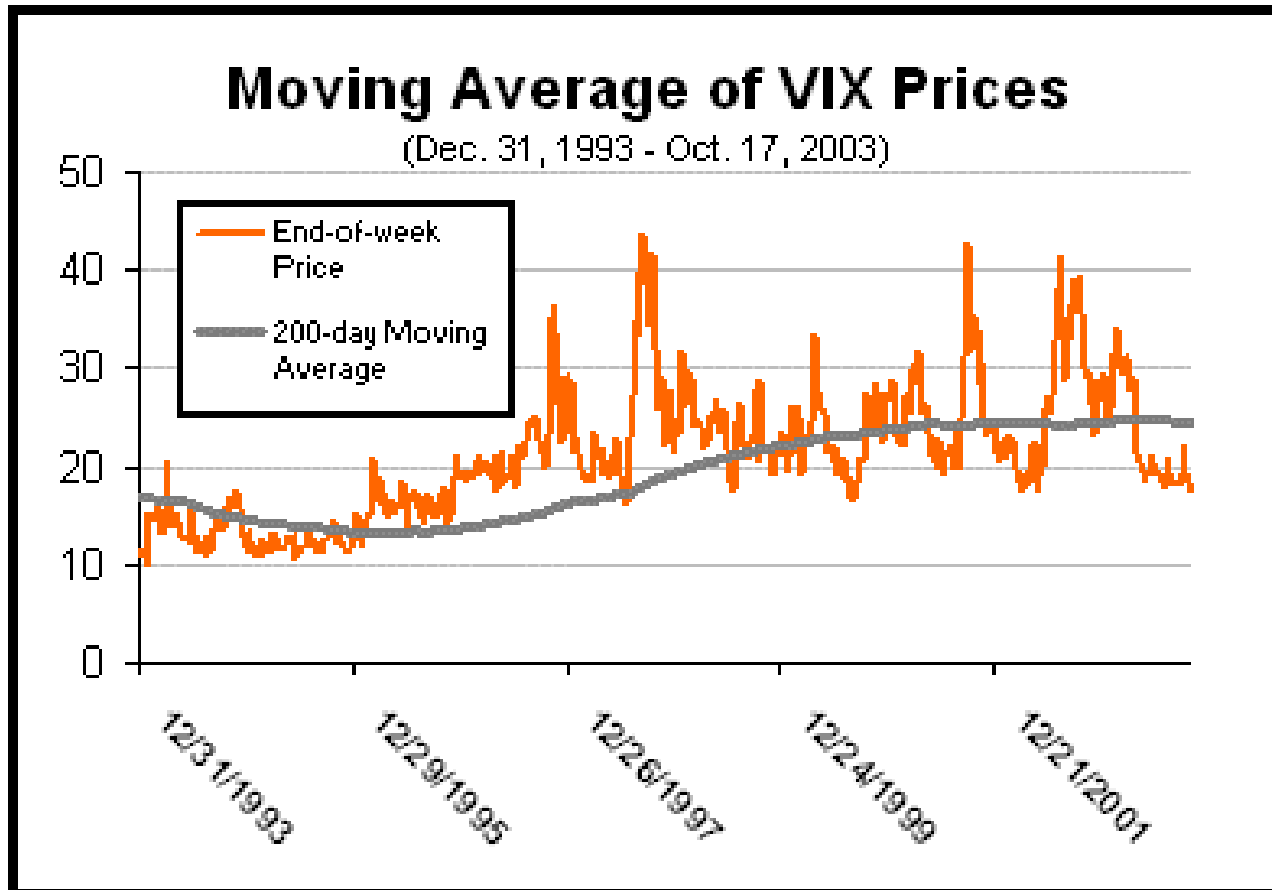
Volatility Index Futures

Fully electronic trading --- CBOEdirect
Clearing --- OCC (Options Clearing
Corp.)

VIX and S&P 500



Mean Reversion



VIX Futures

Possible Uses Include --

- To take advantage of a **market view** on the direction of near- term volatility,
- To **hedge** volatility risk with short VIX futures or long protective VIX puts,
- To manage risks associated with the growing markets for volatility and **variance swaps**,
- To take advantage of **arbitrage opportunities** between S&P 500 (SPX) options and VIX futures and options.