

Volatility Dispersion
Presentation for the CBOE Risk Management Conference

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Volatility Dispersion

- This is a term that's been bandied about

- Typically means:

“I have volatility exposure in one or more instrument, can I get rid of it using other instruments”

Volatility tracking

- Market makers used to sell options on the US dollar / Swiss franc and hedge using the US dollar / German mark
- As long as both currencies moved in tandem, this worked rather well
- But – there were periods where the currencies diverged and the hedge fell apart

Past correlation

- In the pervious example, there was a relationship between the currencies that has been observed in the past
- It does *not* mean that it will be sustainable in the future

Types of Equity Indexes

■ Focus of Index

- Broad Index (S&P 500, Nasdaq)
- Narrow (industry group) index (e.g. Semiconductor index, Health Care index)

■ Weighting

- Market Cap weighted (e.g. S&P 500, Nasdaq)
- Equally weighted price (Dow Jones)
- Equally weighted return index (e.g. the Value-Line index)

Index to component arbitrage

- Many try to arbitrage between the index (e.g. DJIA) and its components stocks
- Others also include futures (DJIA index futures)
- This relationship has been “arb-ed to death”

Relationship scale

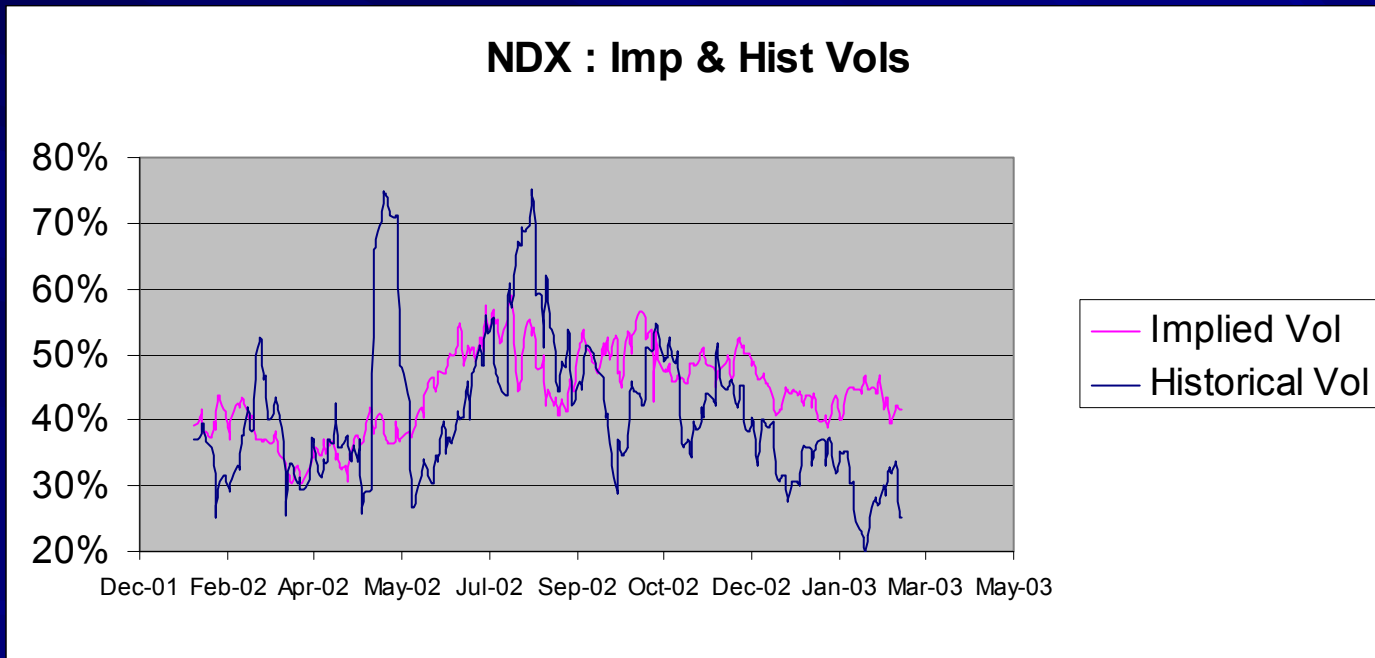
- Simple relationship (e.g. index to components – easy to do so there is not much profit potential)
- Historical relationship (very dangerous - high possible profits but also high potential risks)
- In the middle: relationship between the implied volatility of the index and the implied volatility of its components

Index options

- Some index options are only traded at a single exchange as compared with equity options which may be traded at up to five exchanges
- Index options have high bid-ask spreads as compared to single stock options
- Have high implied volatilities as compared with the historical volatility of the index

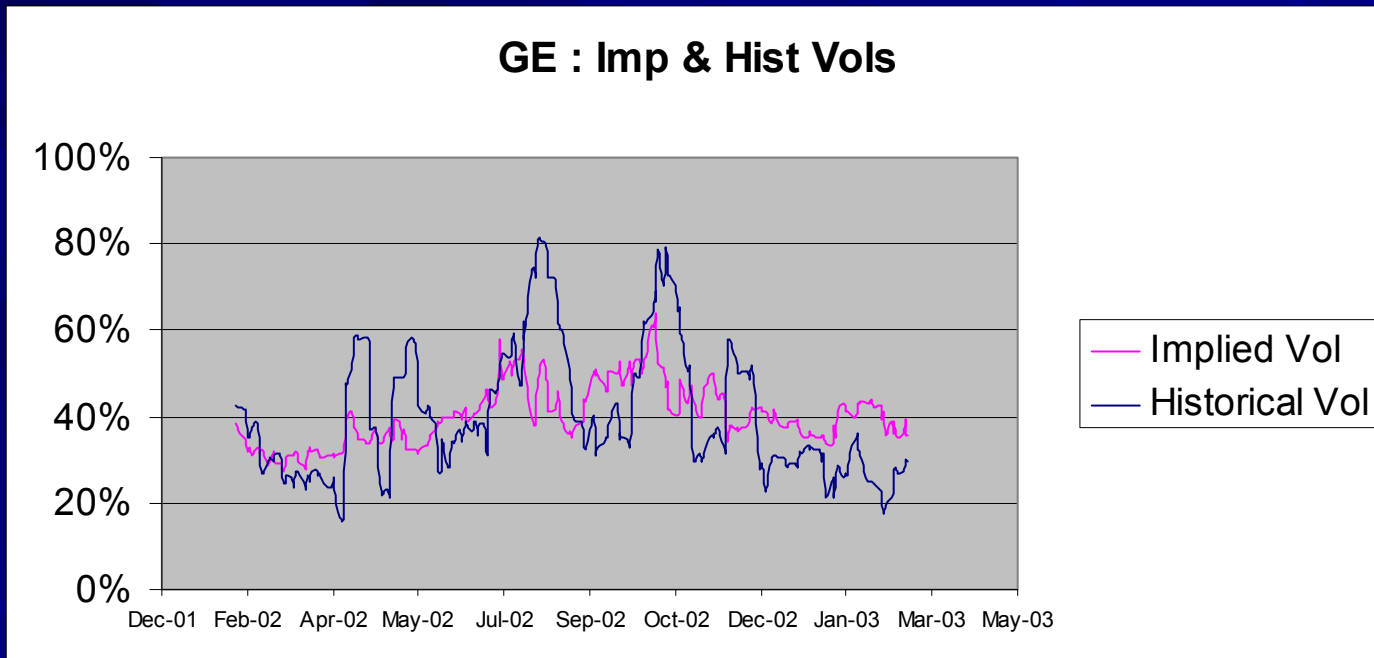
Implied vs. Historical – NDX

Avg Hist 41.43%, Imp 44.28%



Implied vs. Historical – GE

Avg Hist 40.03%, Imp 40.13%



Hedge Fund Strategy - I

- Some hedge funds just sell options on the index:
- Sell at the money near term (1-2 months) S&P options
- Buy far from the money 1-2 months S&P options
- As the hedge fund says...
 - Natural suppliers of index options do not exist
 - Buyers must pay a premium
 - Benefit from overpricing on index options

Rationale

- Because the implied is higher than the actual volatility
- So they collect more premium than they risk to their capital
- Example: Acorn Derivatives

Hedge Fund Strategy - II

- Sell index options – close to ATM straddles or strangles
- Buy component options

Why not the reverse?

- Short index options
- Long component options
- ... not the reverse
 - Index options are expensive
 - You can be surprised with a single stock (e.g. bankruptcy, takeover, earnings surprise) but not with the entire index

Delta hedging

- Each are Delta hedged with its own underlying
- As this is a hedged position...
- They get a better treatment from the clearing firm

- It is really a “volatility” play – or more precisely a “correlation” play

Examples

- The Barracuda fund of Artradis in Singapore
- Balanced Asset Management of Hungary
- Our fund (Keren Asset Management) in the USA may also employ this strategy

- The Buy-Write index takes advantage of the same phenomena

Market Makers

- Are attracted by the high bid ask spreads in index options
- They sell these index options...
- ...and benefit from high implied volatilities
- ...as well as the large bid-ask spreads
- Market makers may find it difficult to buy them (as natural sellers may be hard to come by)
- So – they need to hedge their volatility exposure (vega)

Reducing vega

- By purchasing component options which are relatively cheap
- ... and have low bid –ask spreads

High Volatility

- Typically, volatility rises when markets tumble
- Stock drop across the board
- Correlation is high

- Sell straddles in high volatility environments
- ... but worry: “can volatility increase even more”?
- Volatility dispersion is a way to reduce the risk
- ...Since correlation is bounded ≤ 1

The Portfolio Equation

$$Var_p = \sum_{i=1}^n \sigma_i^2 w_i^2 + \sum_{i=1}^n \sum_{\substack{j=1 \\ i \neq j}}^n \rho_{i,j} \sigma_i \sigma_j w_i w_j$$

$$\sigma_p = \sqrt{Var_p}$$

Portfolio Equation - II

σ = standard deviations of returns

ρ = correlation of returns

w_i = weights for each security

Currency Options

- The portfolio equation is used by foreign currency (forex) option participants
- Forex option triangle:
- Participants know the volatility on:
 - USD/Euro options
 - USD/JPY options
 - Euro/Joy options

From here, we can get at the correlation numbers

Two stock index

- Given the two implied volatility numbers
- and the index implied volatility

- We can deduce the correlation number – this is the “implied correlation”
- If it is much higher than the historical correlation number – it may be a good trade

Hypothetical Example

	Weight in Index	Implied Volatility
Stock A	70%	30%
Stock B	30%	40%
Correlation	70%	
Volatility of index	30.62%	

Question

- Sold 100 index ATM straddles
 - How many straddles in each component?

- Sold 100 index slightly out-of-the-money call options
 - How many call options in each component?
 - Which strikes should you use?

Equating “Greeks”

- Delta's are hedged in each instrument separately
- If the trader sold 5000 Gamma (or Vega) units on the index option
- ... they would like to have an equivalent amount in the component options

Profit

- If the implied correlation comes back in line with normal levels
 - by index implied volatility dropping
 - by component implied volatility increasing
- Then the trade makes money

- Windfall win – when one stock jumps up and the other down
 - The index is unchanged
 - The component options made money

Danger

- As the stocks & index move these options may no longer be close to ATM
- So even if the implied volatility numbers came in line
- ...you may not have made any money
- Do you readjust the option position?

Correlation “explosion”

- The trade is a “bet” that correlation will return to normal levels
- If correlation continues to increase (e.g. due to all stocks moving in the same direction) the trade may, in fact, lose money

Broad vs. Narrow indexes

- Broad index has many constituents so must buy many component options and manage them
- Narrow index has few component options so it is an easier trade
- Sector index has high levels of correlation to start out with – when it is really high – there is not too much correlation risk (the most it can go to is 1)

Index weights

- As the stocks move up and down, their relative weightings in the index change
- This impacts on the index implied volatility
- If a stock moves down dramatically, then its weight in the index drops. On the other hand, its implied volatility increases
- These effects tend to partially cancel each other

Many stocks

	Weight in Index	Implied Volatility
A	10%	30%
B	15%	40%
C	20%	45%
D	25%	40%
E	30%	45%

Correlation matrix		A	B	C	D	E
A		100%	70%	30%	60%	70%
B		70%	100%	60%	50%	40%
C		30%	60%	100%	60%	50%
D		60%	50%	60%	100%	70%
E		70%	40%	50%	70%	100%
Index Volatility		33.918%				

Difficulty

- With many stocks, we can not uniquely determine an implied correlation matrix
- One method...
 - Use the historical correlation and the implied volatility
 - Compare the resulting volatility with the actual implied volatility of the index

How to compare?

- If the implied volatility of the index is 35% but the result of the computation is 33% - is that enough to be a seller?
- Need some way to assess the relative implied volatility differential (e.g. on a historical basis)

More difficulties

- We do not hedge with the entire index
- But with a select group of stocks
- These are
 - the heavily weighted stocks – large market cap
 - the ones with large liquidity
 - the ones with large implied volatility numbers
- How many stocks should you choose?

Lag Risk

- It is often impossible to place all the legs of this trade simultaneously
- .. so the trade is exposed to lag risk

Volatility dispersion models

- Ivolatility.com
- Brisk systems
- ... and others

Profit attribution

- Why did we make money on a particular trade?
- Was it a result of implied correlation coming in?
- Or perhaps the trader accumulating Deltas?

Science & Art

- We have developed volatility dispersion tools for consulting clients
- These models are quite mathematical
- But volatility dispersion trading is also an art
- Beware of a “black box” model