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# Volatility Investment Fundamentals:

A Review of Instruments Commonly Used to Trade Volatility

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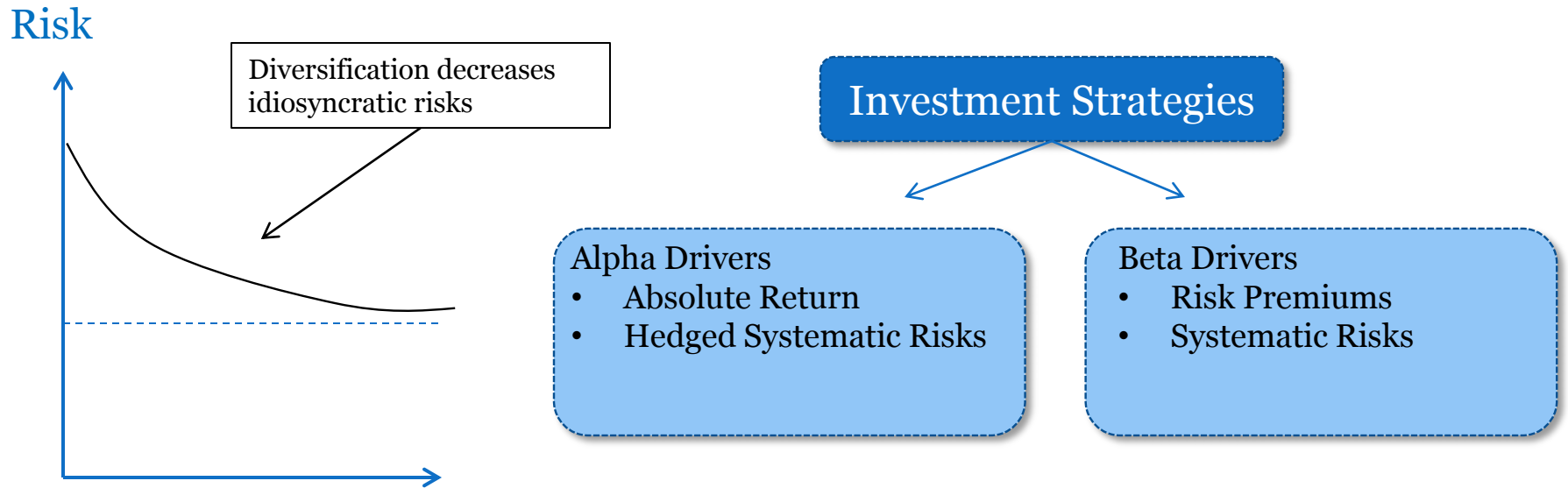
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# Outline

- Motivation: Why?
- Fundamentals: What?
- Investment Strategies: How?
- Investment Instruments: With What?

# Basic Principles



Investor Takeaway: One can optimize your portfolio return by combining cheap beta exposures and augment return by adding absolute return strategies which are uncorrelated to those exposures.

What's wrong with this picture?

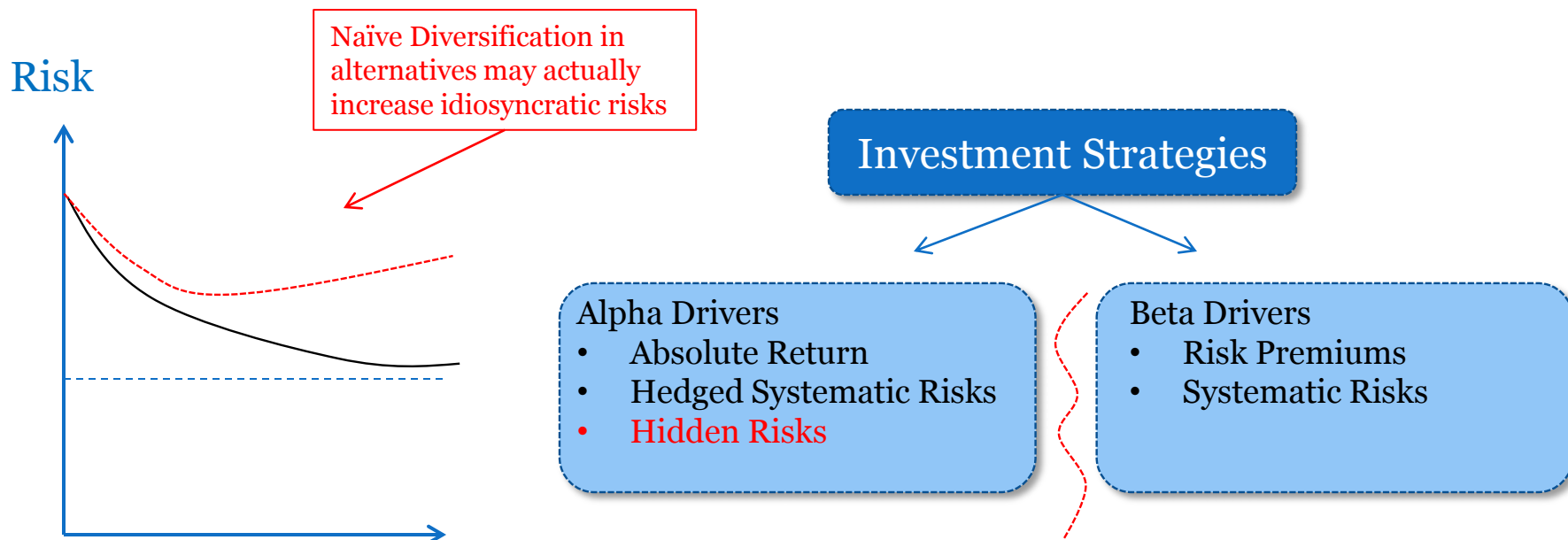
# Lack of Diversification

Recent research in hedge funds during crisis has demonstrated that many hedge funds are holding *common latent idiosyncratic risks* in credit, liquidity, and **volatility**. (Billio, Getmansky, and Pelizzon 2010)

- Most risk measurement techniques are based on divergent approaches which may hide potential risks in non-divergent strategies.
- During crisis many hedge funds deal with issues related to funding liquidity, margin spirals, redemptions, etc.
- For many hedge funds, risks are about “magnified basis risks” or “tail risks”

These hidden risks, if not properly accounted for, can result in a lack of diversification and a non alpha beta separation.

# Basic Principles



\*\*\* Tail Risks may cause “absolute return strategies” to be less than absolute

Investor Takeaway: One can optimize your portfolio return by combining cheap beta exposures and augment return by finding absolute return strategies which are uncorrelated to those exposures during non-crisis periods. Potential losses during crisis events should be offset to mitigate the potential for extreme losses.

How?

# Why are we here?

If you are really looking for diversification, you should find investments that **like crisis and volatility**.

- Tail hedging programs
- “Crisis alpha” generators

Crisis alpha opportunities are the potential profit opportunities which can be gained by exploiting the persistent trends that occur during and following market crisis periods (Kaminski 2011,2012).

Crisis alpha generators are alternative investment strategies which may have access to these opportunities.

# Volatility Basics

**Volatility** refers to the amount of **uncertainty or risk** about the size of changes in a security's value. A higher volatility means that a security's value can potentially be spread out over a larger range of values.

*Source: Investopedia*

**Risk** is defined as the possibility that an outcome will not turn out as you expect it.

**Uncertainty** is a situation where the consequences, extent or magnitude of circumstances, conditions, or events is unknown.

# Risk vs. Uncertainty

Consider the following game. Urn A is filled with colored balls

- 50 red balls and 50 black balls
- Select a color red or black
- If your color is selected I will pay you \$10,000
- What would you pay to play this game?



# Risk vs. Uncertainty

Consider the following game. Urn B is filled with colored balls

- Red balls and black balls unknown quantities
- Select a color red or black
- If your color is selected I will pay you \$10,000
- What would you pay to play this game?

Why?

# Conceptualizing Volatility

Volatility is the amount of uncertainty or risk in the future value of an underlying security or asset.

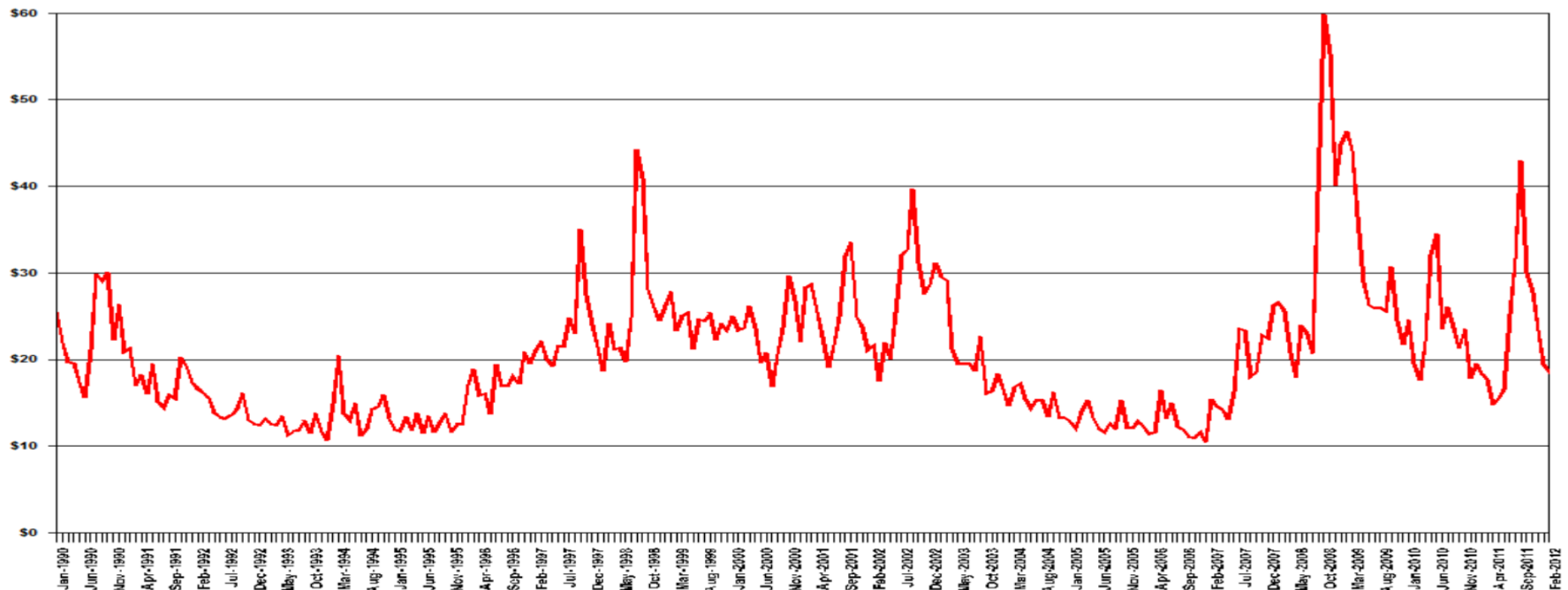
Past volatility tells us about the risks we faced, while the current value of future volatility is governed by our perceptions of uncertainty going forward.

As market participants buy and sell assets as well as buy or sell contracts dependent on future volatility, they incorporate their views on or perception of future uncertainty.

# Empirical Properties of Volatility

Some common empirical properties of (equity) volatility

- It tends to be anti-correlated with the underlying over short periods.
- It can increase suddenly in “spikes”.
- It goes through different regimes or cycles
- It tends to be mean reverting (with-in regimes)

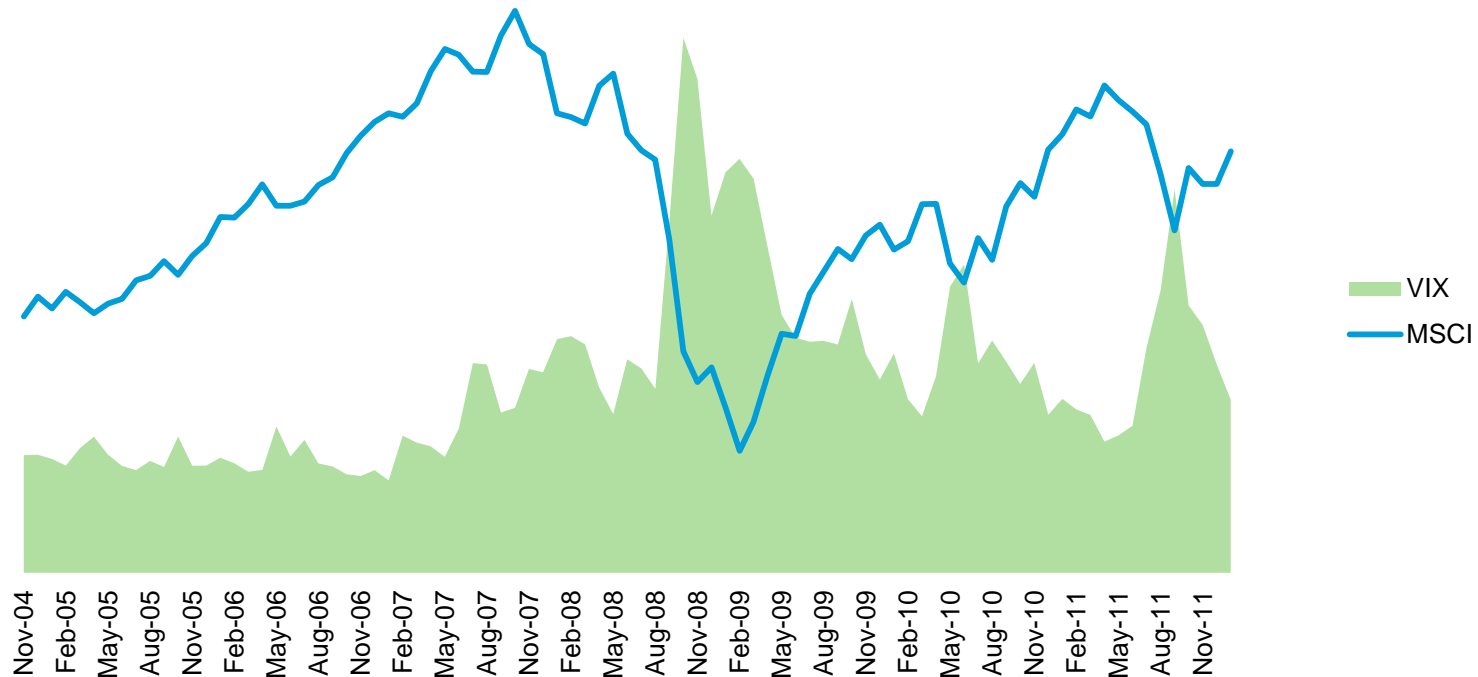


CBOE VIX: Source: Bloomberg

# Conceptualizing Volatility

Since volatility is really about market participants perceptions of future uncertainty or risk, the level of volatility in markets can be linked to behavioral finance.

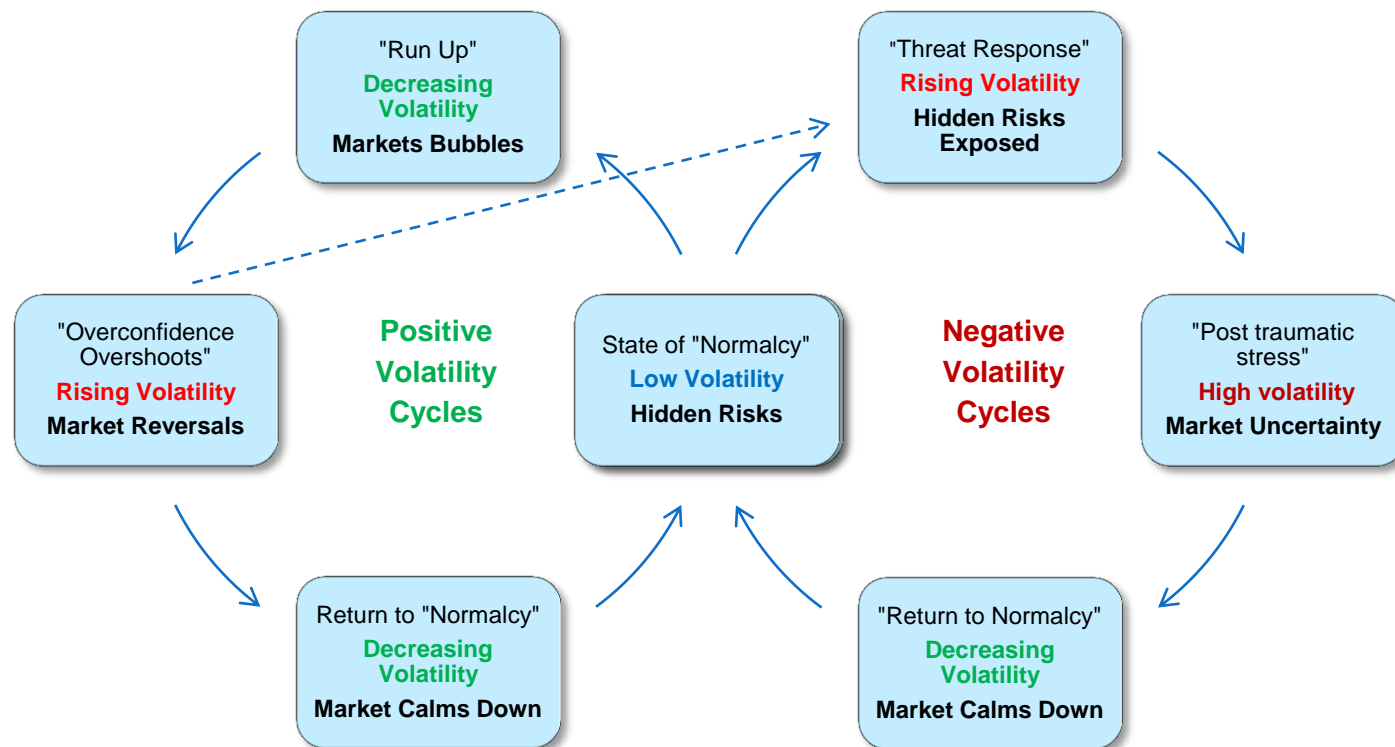
## Inverse Equity Volatility Relationship



Source: PerTrac, Bloomberg

# Volatility Cycles

Negative volatility cycles are driven by fear, anxiety, and distress. Positive cycles are driven by greed, exuberance, and overconfidence. Risk preferences are conditional on past experience.



Coates, Gurnell, and Sarnyai (2010) and Coates and Herbert (2008) examine the role of steroids hormones and their role in financial risk taking using physiological data as well as performance data from real traders on a London trading floor. They show that testosterone is directly linked to return while cortisol (the stress hormone) is directly linked to uncertainty (as measured by implied volatility) and risk taking (variance in the P&L of market participants). Their research may help provide the link between economics and neuroscience. Cycles in hormone production have often been used by biologists to explain animal behavior in competitive settings.

# Measuring Volatility

Two common methods for measuring volatility

- Backward looking – realized volatility (standard deviation)
- Forward looking – implied volatility

Implied volatility is the level of volatility implied in option prices. Since options are dependent on the futures value of volatility and extreme events, the buying and selling of these contracts provides information concerning market participants views on volatility.

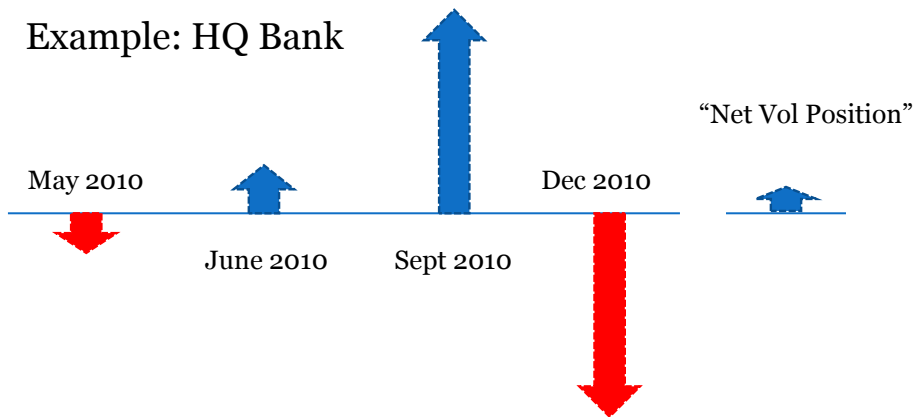
# Measuring Volatility

One of the toughest issues with volatility is in how it is measured.

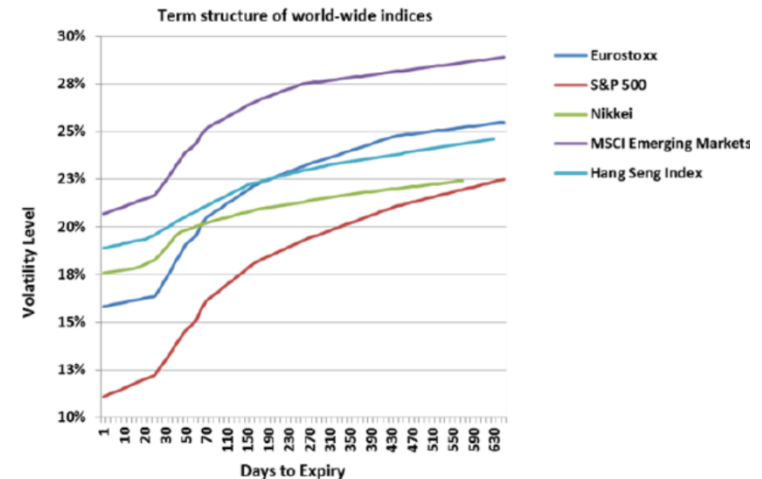
Volatility needs to be characterized by

- Underlying
- Time horizon (Short term, long term)
- Frequency for measurement (daily, intraday, etc.)
- Method of measurement (implied: black-scholes, other models, etc. realized: standard, root mean squared)

Example: HQ Bank



Source: Commentary and Presentation, Lars Frisell Chief Economist, Swedish Financial Supervisory Authority



Source: Ohnana, J., Capstone Investment Advisors

# Uses for Volatility

Many investors view **volatility as an asset class** which means that one can think of hedging volatility exposures and earning volatility risk premiums.

Major uses of volatility include

- Taking a directional view on volatility (a volatility bet)
- Diversifying a portfolio – (volatility can be seen as an asset class)
- Immunizing volatility risk of hedge fund strategies
- Hedging – (macro, tail, or other types of hedging of volatility exposures)
- Rolling short variance – (earn the volatility risk premiums)
- Relative value trading (possibility to extract alpha)

Important Distinction: Almost all techniques for dealing with tail events are in volatility, yet only some techniques for investing in volatility are about tail events.



# Investing in Volatility

Coupling measurement issues and the uses for volatility, there are many, many approaches to investing in volatility:

	Straddle	Delta-hedged options	Variance swap	Gamma swap	Conditional variance swap	Corridor variance swap	Correlation swap
Volatility bet	+	+	++	++	++	++	-
Volatility hedging	-	-	++	+	+	++	-
Dispersion trading	+	-	++	++	-	-	-
Correlation trading	-	-	++	++	-	-	++
Asymmetric volatility bet	-	-	+	+	++	++	-
Smile trading	-	-	++	++	+	+	-

Source: BNP PARIBAS, Equity Derivatives Technical Study, Don Chance, BNP PARIBAS Arbitrage

# Investing in Volatility

All investments are subject to volatility.

**Vega** is a measure of the sensitivity of a contract to changes in volatility. Vega is a simple way of estimating how much your position will change if there is an increase in volatility. Given this terminology, equity positions have negative vega i.e. they will lose money than gain “on average” when volatility increases.

**Volatility risk premium** – long volatility positions are biased to make a loss. Investors may not truly be “risk neutral” meaning they will pay a premium for exposure to long volatility.

- Long volatility is similar to buying insurance
- Short volatility is similar to selling insurance

# Volatility Instruments

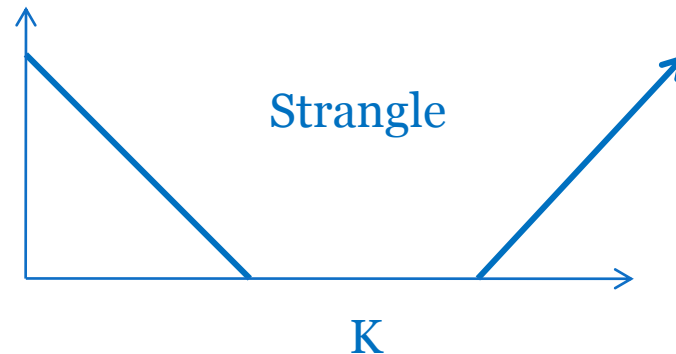
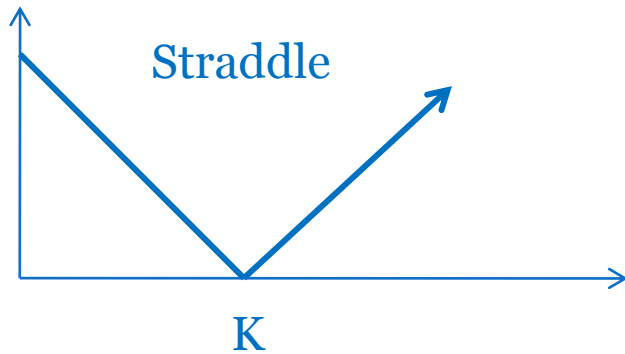
- Options (Straddles and Strangles)
- Volatility and Variance Swaps
- Volatility Futures
- Options on Volatility Futures

Key issues to think about with each type of contract

- Nature of either volatility exposure (are there other risks? Linear or convex? Possible use for tail exposure?)
- Counterparties (exchange traded vs. OTC)
- Liquidity (market volume)
- Relevant limits to downside risk
- Implicit Leverage

# Options and Volatility

Option contracts depend on the *current value of the stock, strike values, interest rates, maturity, and the volatility of the underlying.*



Investors who take a straddle or strangle are **betting on extreme events in the underlying.**

- Straddles and Strangles do not provide a pure exposure to volatility. If the underlying moves in either direction, the delta of the portfolio of calls and puts changes adding exposure to the underlying itself. This dependence makes the exposure to volatility path dependent.

# Options and Volatility

Imagine the following example, a stock is currently trading at 100.

- Purchase a 3 month ATM call and a 3 month ATM put
- If the stock goes up and down throughout, the three month period but ends up back at 100. Your position is worthless if held to the end despite the fact that the realized volatility being high. This example shows how options are trades on extreme events not pure volatility.

One potential solution would be to delta hedge the straddle position to remove some of the other risks and path dependencies using options. But, there are practical issues...

- Volatility path dependence
- Transaction costs and liquidity issues

Thus, most people do not do this in practice – there are other contracts which provide an easier pure volatility exposure (coming up next...).

# Volatility and Variance Swaps

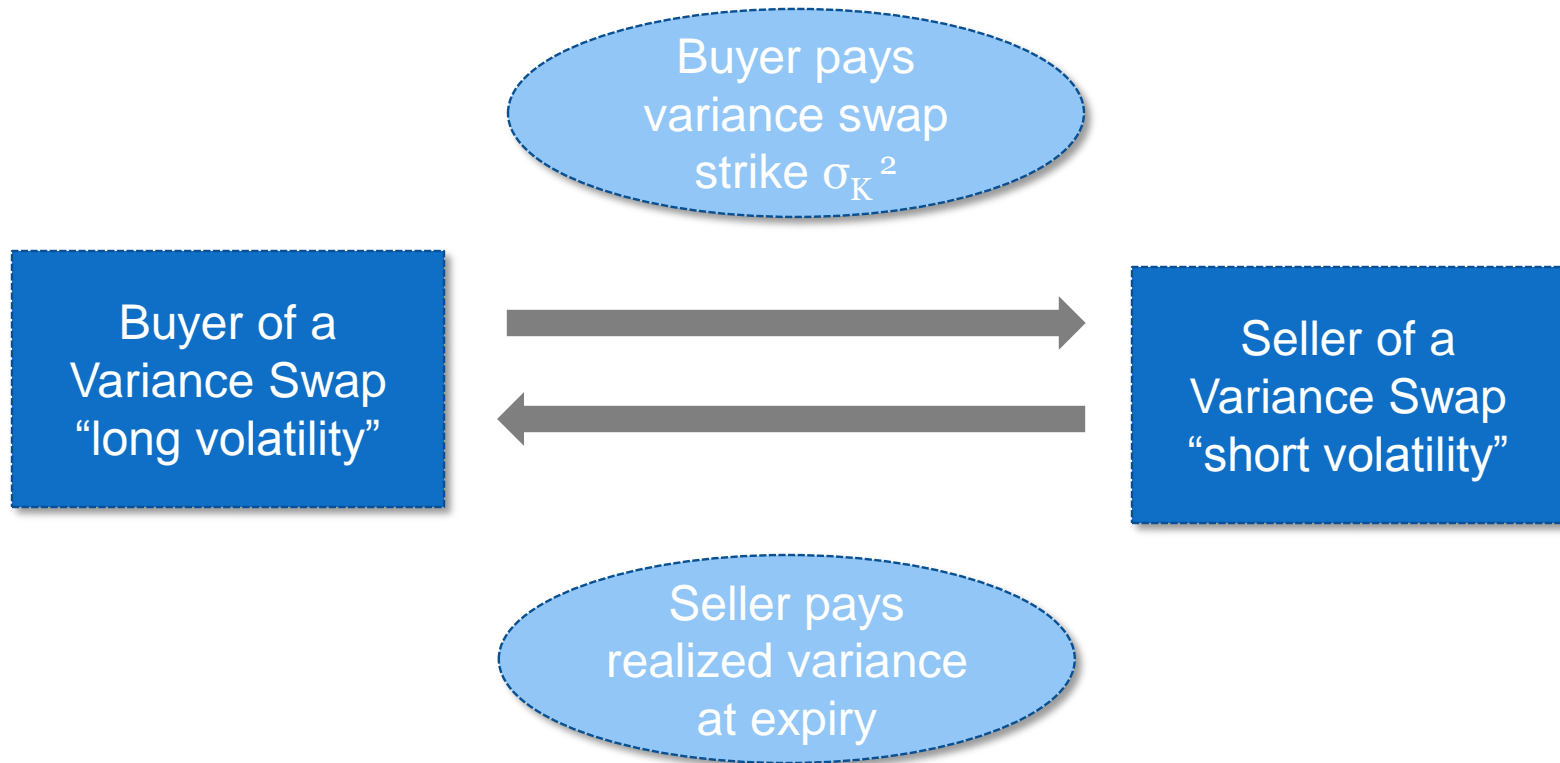
A **Volatility Swap** is an agreement to exchange realized volatility of an asset between time 0 and T for a pre-specified fixed volatility level (strike).

- Realized volatilities ( $\sigma_{\text{Hist}}$ ) are calculated with a mean daily return assumed at zero.
- With the notional principal ( $L_{\text{vol}}$ ) and fixed volatility ( $\sigma_K$ )

$$\text{Payoff of a volatility swap} = L_{\text{vol}}(\sigma_{\text{Hist}} - \sigma_K)$$

A **Variance Swap** is the same as a volatility swap, except the variance is exchanged instead. ( $V_{\text{Hist}} = \sigma_{\text{Hist}}^2$ )

# Volatility and Variance Swaps

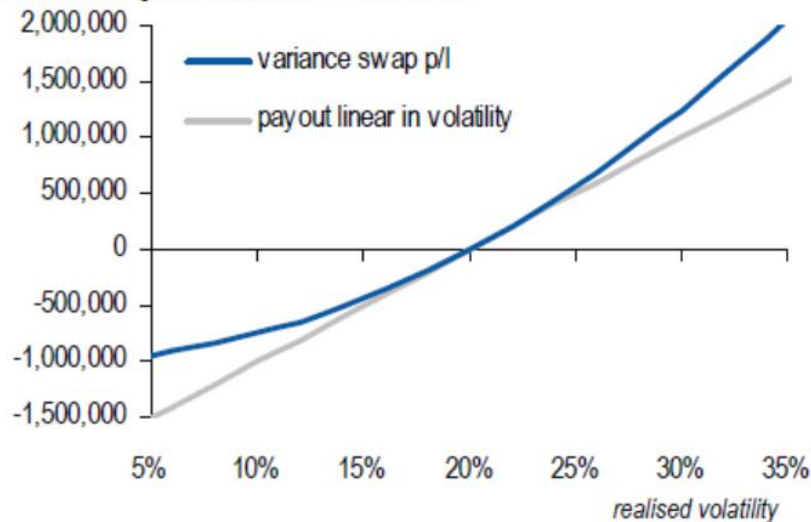


# Volatility and Variance Swaps

- Variance Swaps are linear with variance but convex in volatility.
- Long variance profits more from increases in volatility than short variance profits from decrease in volatility.
- Variance swaps generally trade at a premium to ATM volatility.

Figure 1 : Variance swap payoffs are convex in volatility

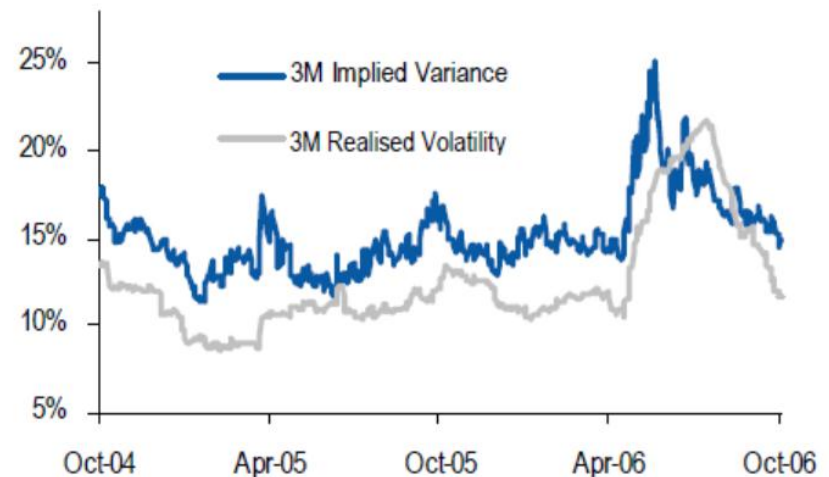
*p/l for 100K vega notional, variance strike of 20*



Source : JPMorgan

Figure 2 : Euro Stoxx 50 implied and realised variance levels

*Euro Stoxx variance*



Source : JPMorgan

Source: JPM, European Equity Derivatives Strategy, Allen, Einchcomb, and Granger



# Volatility and Variance Swaps

## Other details

- Long variance swap positions have limited downside yet short positions have unlimited downside (unless capped).
- If the position needs to be closed out prior to maturity, the position is marked to market including the realized variance since the start and the implied variance from present to maturity.

## Other types and alternatives

- Capped Volatility Swaps
- Corridor Variance Swaps (only take into account daily variations in a specific range), Conditional Variance Swaps, Up and Down Corridors
- Forward Start Variance Swaps
- Gamma Swaps
- Correlation Swaps

# Volatility Futures and Futures Options

Volatility Futures contracts are exchange traded marked to market contracts which represent the delivery of future implied volatility at a certain pre-specified date for an amount agreed upon at the beginning of the contract.

- Volatility futures allow for liquid, low counterparty risk exposures.
- There are also options on volatility futures prices.

# Volatility Strategies

## Potential Strategies for Generating Alpha

- Volatility term structure trades
- Index variance spreads
- Relative value in single stock volatility
- Variance dispersion and correlation trading
- Forward volatility and volatility spikes
- Skew and convexity trades
- Cross asset class trades

# Key Points

- If you want to find diversification, look for investments that like crisis and volatility.
- Volatility is the amount of uncertainty or risk in the future value of an underlying security or asset.
- Volatility can be used for hedging, portfolio diversification, alpha generation, and risk premiums.
- There are a wide array of instruments as well as approaches to investing in volatility and tail events.

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