

## ***Volatility Presentation***

Asset price volatility has declined over the past two years both in the United States and globally. At the same time, forward-looking measures of market uncertainty across a range of fixed income, equity, and foreign exchange markets have also declined.

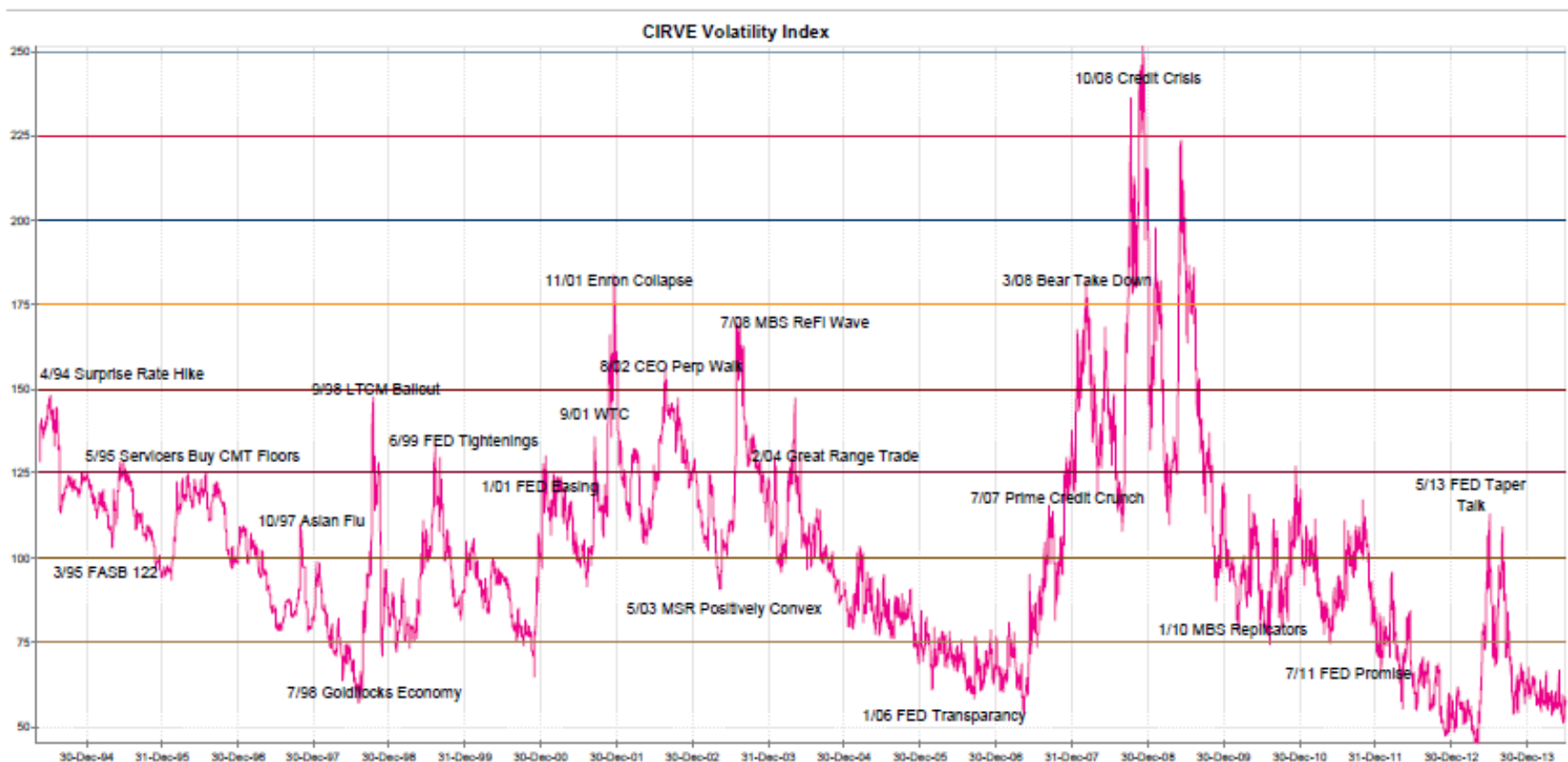
What are the Committee's views on these developments and the factors that have contributed to the current environment of low volatility globally?

## Current state of volatility

Monthly count of Bloomberg articles that contain the phrase “low volatility”.



# Current state of volatility

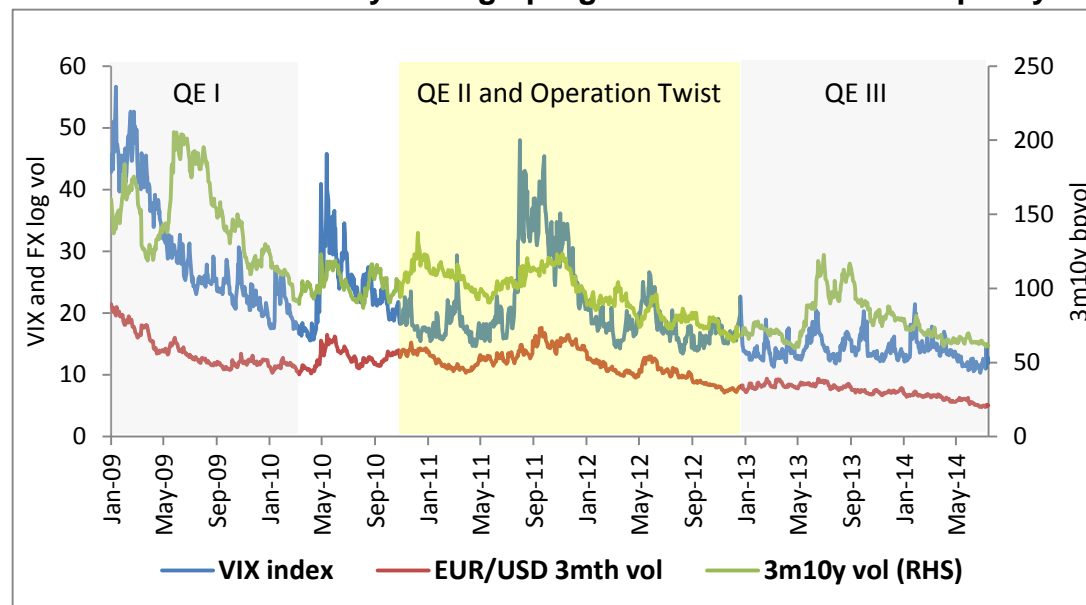


Credit Suisse Interest Rate Volatility Estimate: yield curve weighted index of normalized implied volatility on a rolling series of constant at-the-money one-month expiry swaptions weighted across benchmark maturities 2yr, 5yr, 10yr and 30yr.

# Factors contributing to low volatility

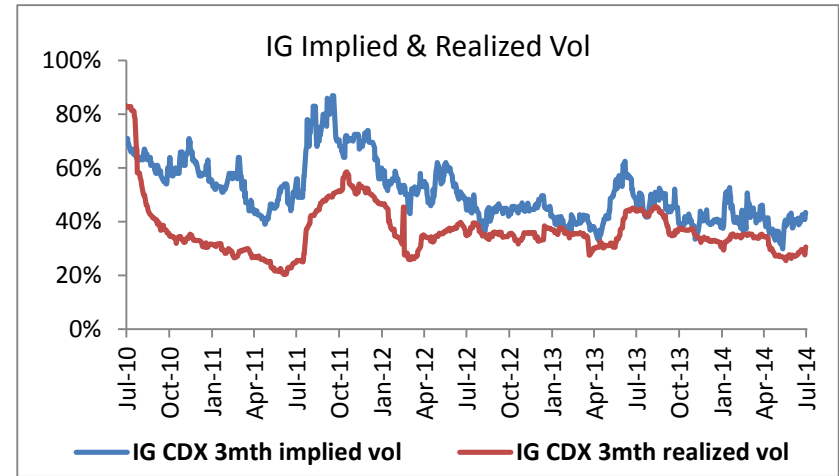
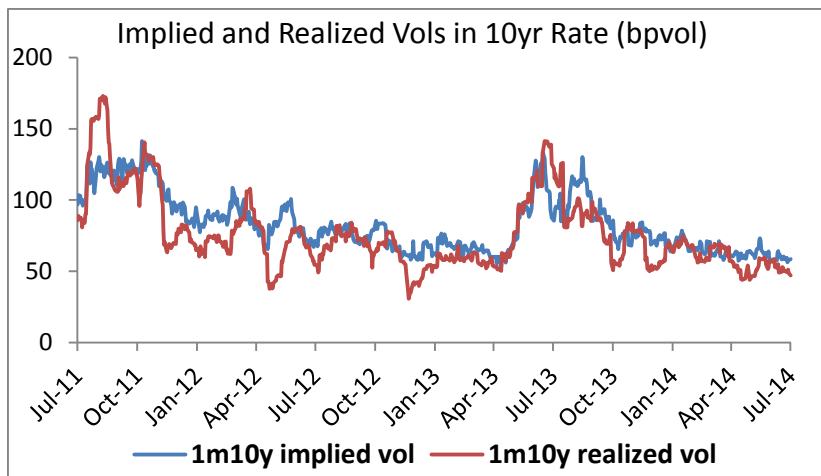
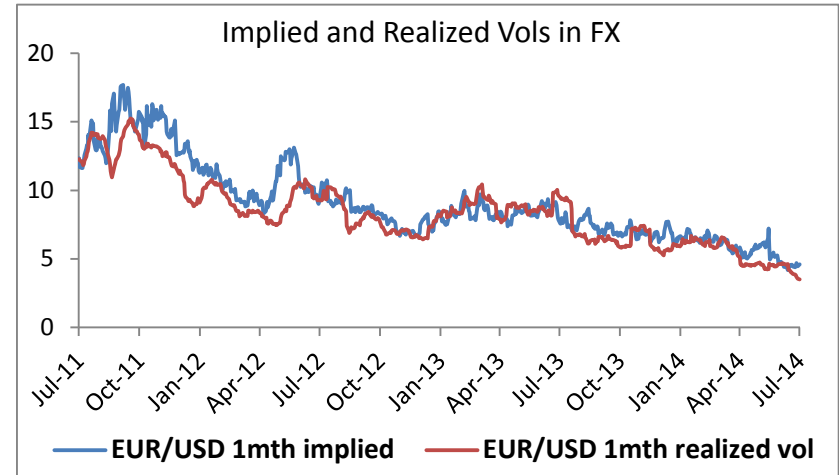
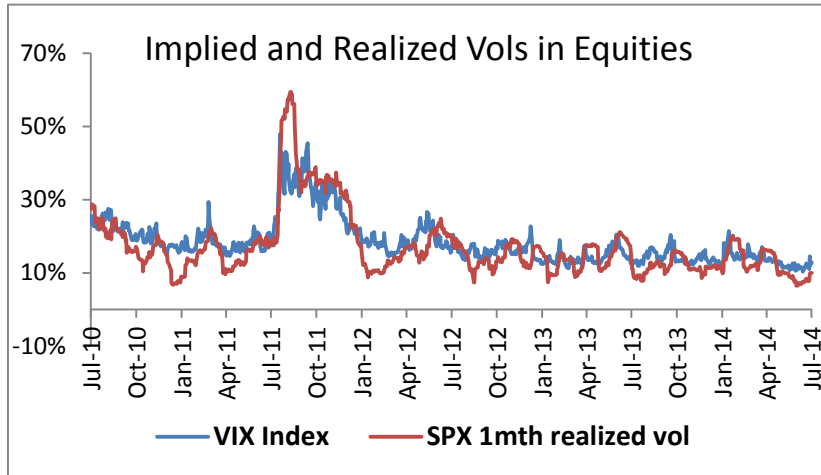
1. Actions by the Fed and ECB have significantly clipped the left tail risk, in terms of both economic outcomes and market outcomes (QE I)
2. As interest rates approached the zero lower bound, rate vol is lower by construction which leads to maturity extensions, lower term premia and declining volatility across other asset classes through a lower and more certain discount rate (QE II)
3. Suppression of yield and vol induces investors to take on more risk (QE III). The market clings to perception of certainty regarding outcomes, despite the Fed shifting commitment modes from time or level-based to data dependent. This stage of policy should eventually lead to increased uncertainty and risk.

**Cross asset volatility through progression of central bank policy**



# Short term price volatility versus long term economic uncertainty

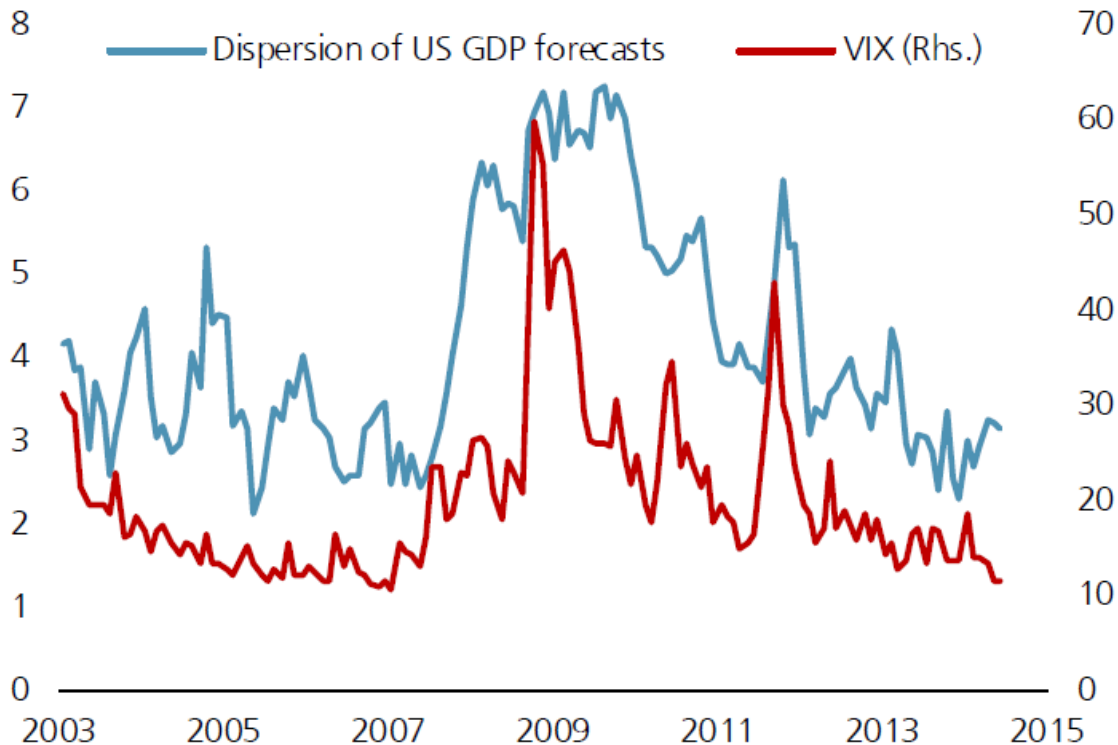
Realized volatility is extremely low, which leads to lower implied volatility in a self-reinforcing loop.



# Short term price volatility versus long term economic uncertainty

Dispersion among Wall Street analyst forecasts for GDP is falling

- VIX level on right hand scale
- Standard deviation of US GDP forecasts provided to database on left hand scale

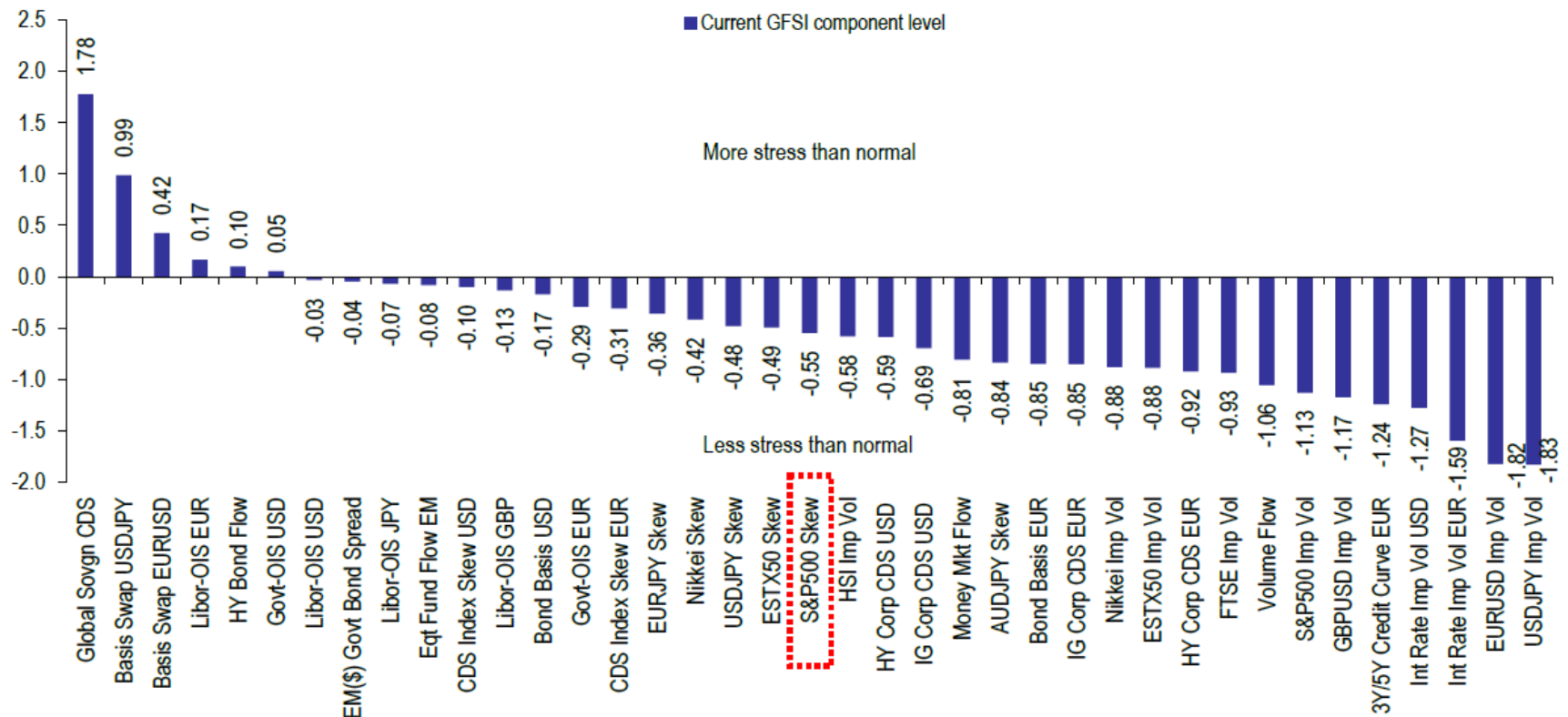


# Short term price volatility versus long term economic uncertainty

The Global financial Stress Index (GFSI) measures

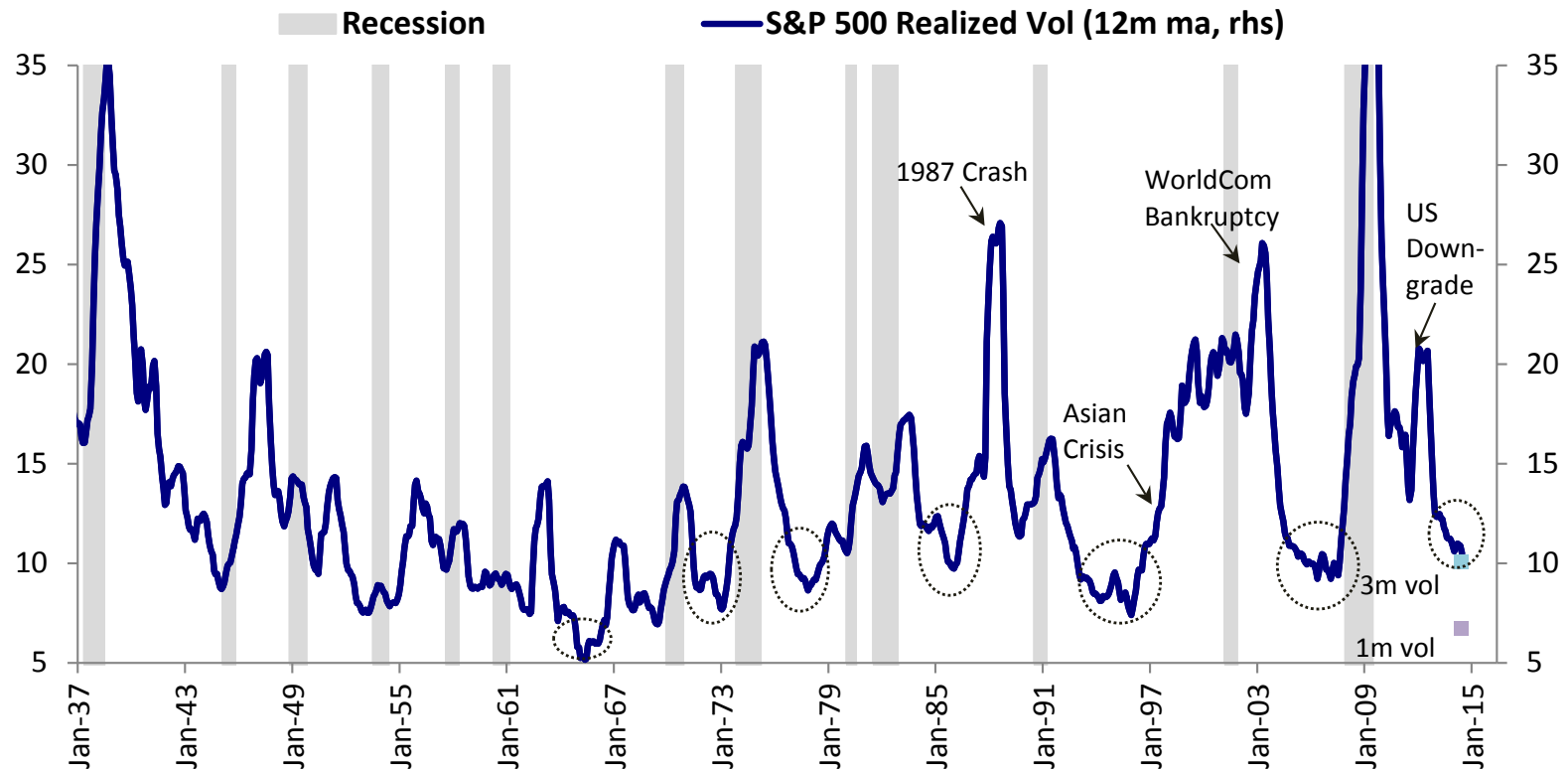
- Risk as indicated by cross-asset measures of volatility, solvency and liquidity
- Hedging demand implied by equity and currency option skew
- Investor risk appetite gauged by trading volumes and flows into equities and high yield bonds and out of money markets

33 out of 39 indicators point to vol being too low.



# Short term price volatility versus long term economic uncertainty

Realized volatility follows the business cycle – high around recessions, falling with recovery, bottoming out mid to late cycle before turning up again



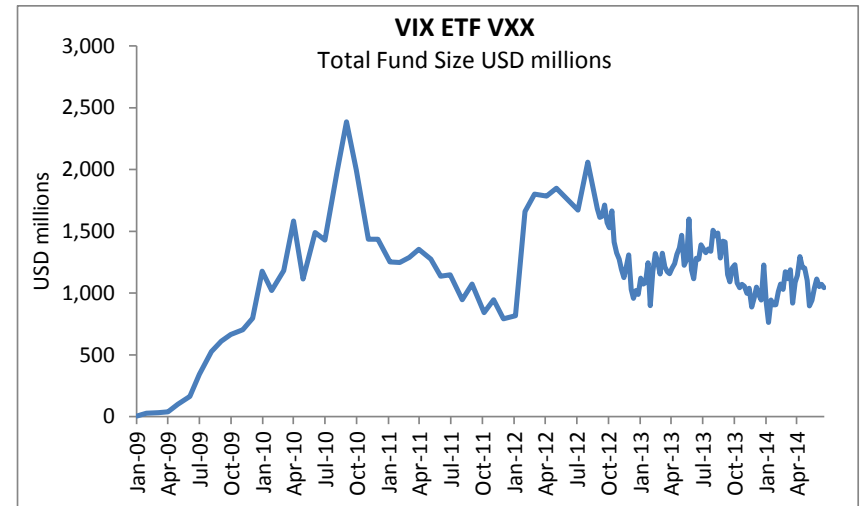
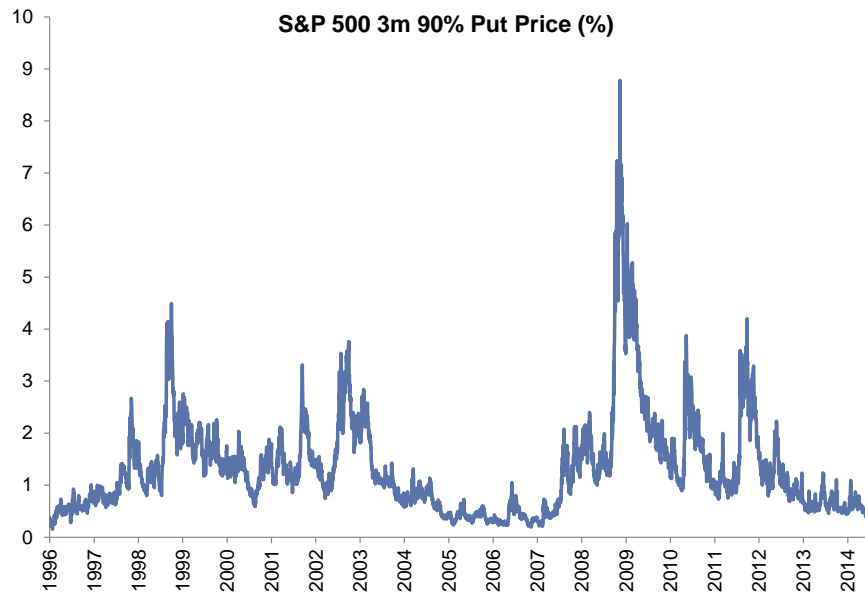
\* Realized vol is the annualized standard deviation of daily log changes in S&P 500 over a 1m window



# Supply / demand factors in the options markets

Tail hedgers have decreased as evidenced by

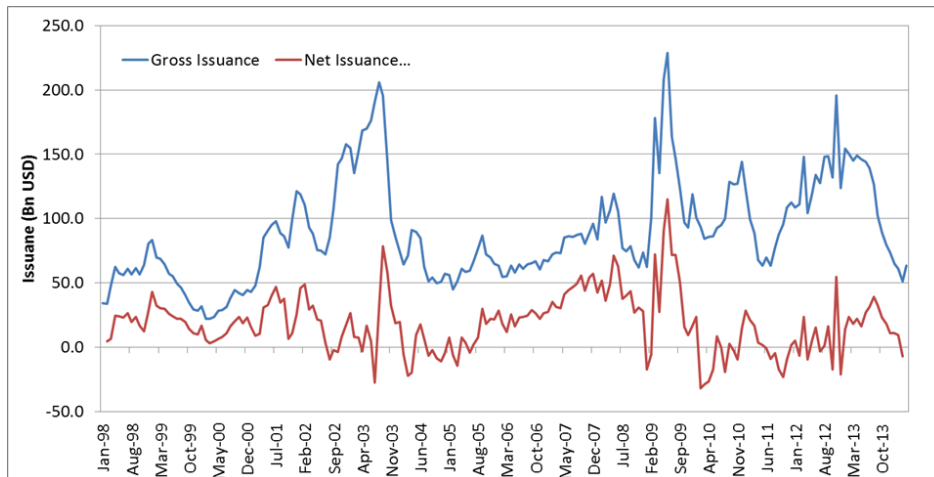
- Falling prices of downside puts on the S&P
- Shrinking fund size of VIX ETF



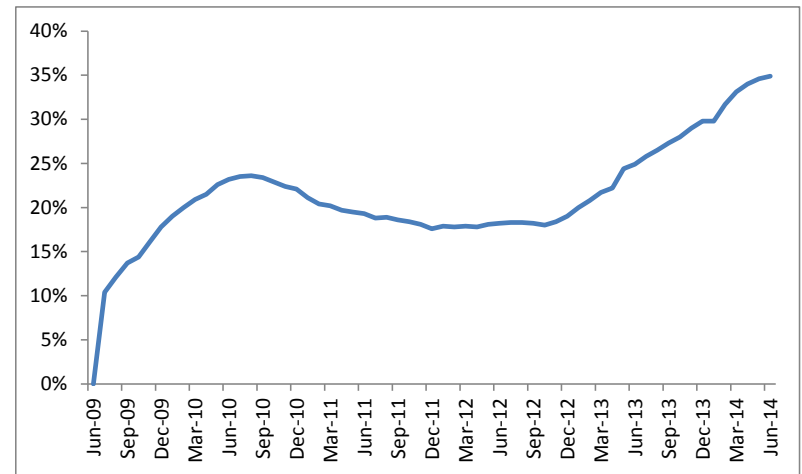
# Supply / demand factors in the options markets

Convexity hedging by mortgage accounts has gone down significantly after the crisis because of lower issuance and the Fed's QE purchases. QE mortgage purchases remove both duration and convexity from the market, making it one of the most powerful policy tools.

**MBS Issuance**



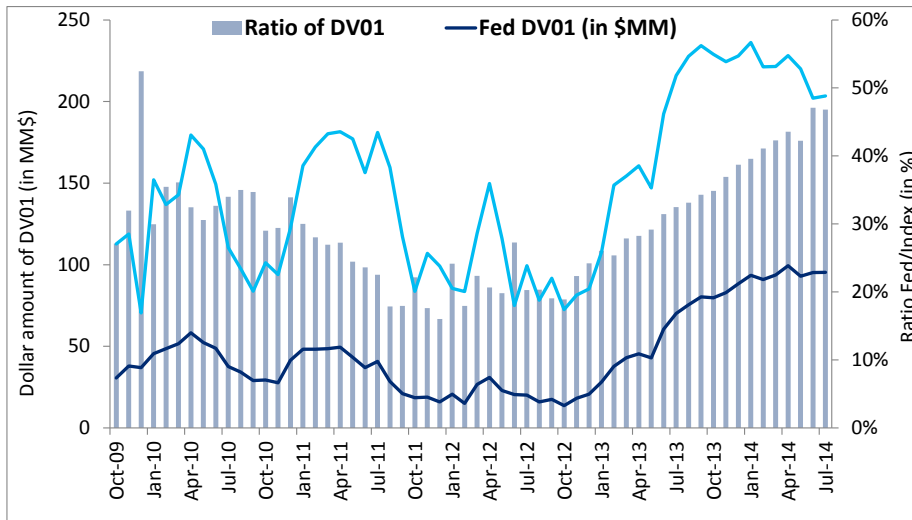
**Fed MBS holdings % outstanding**



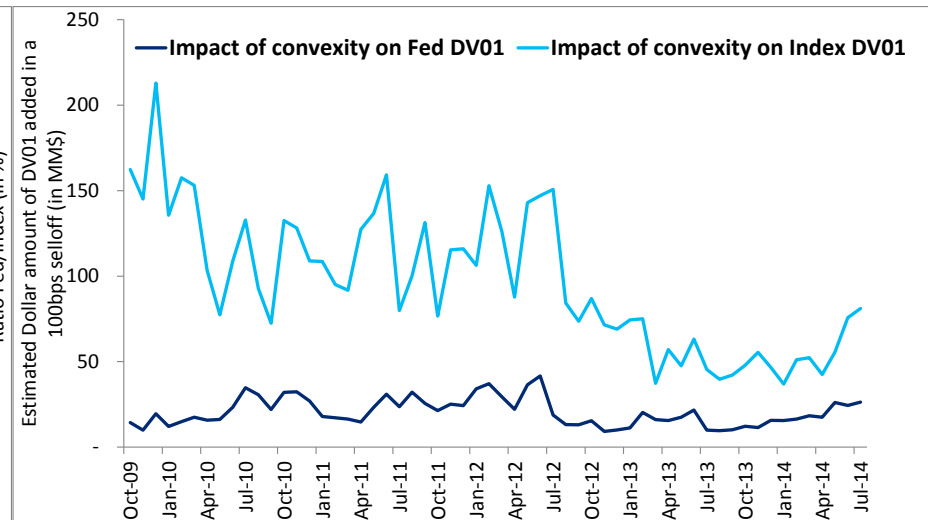
# Supply / demand factors in the options markets

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### Duration effect of QE



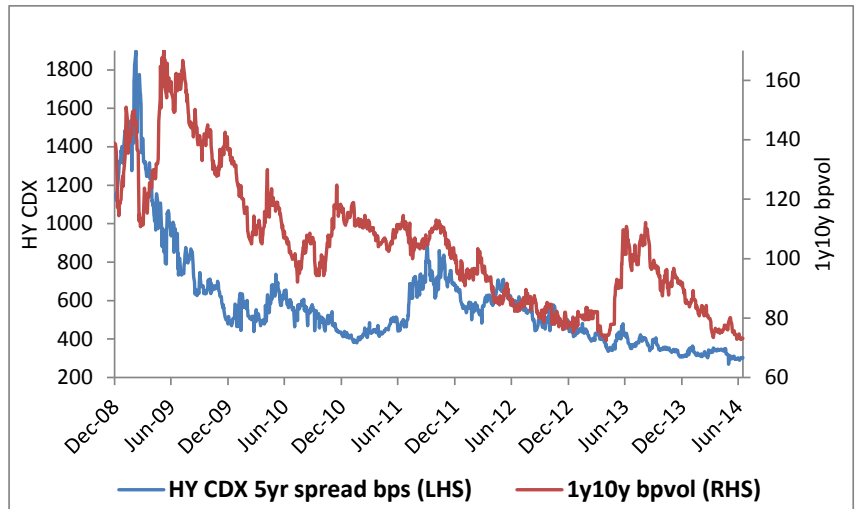
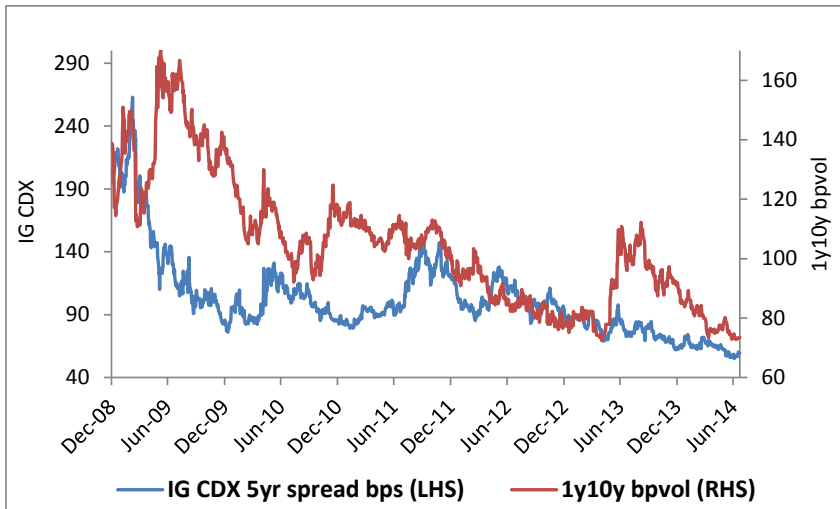
### Convexity effect of QE



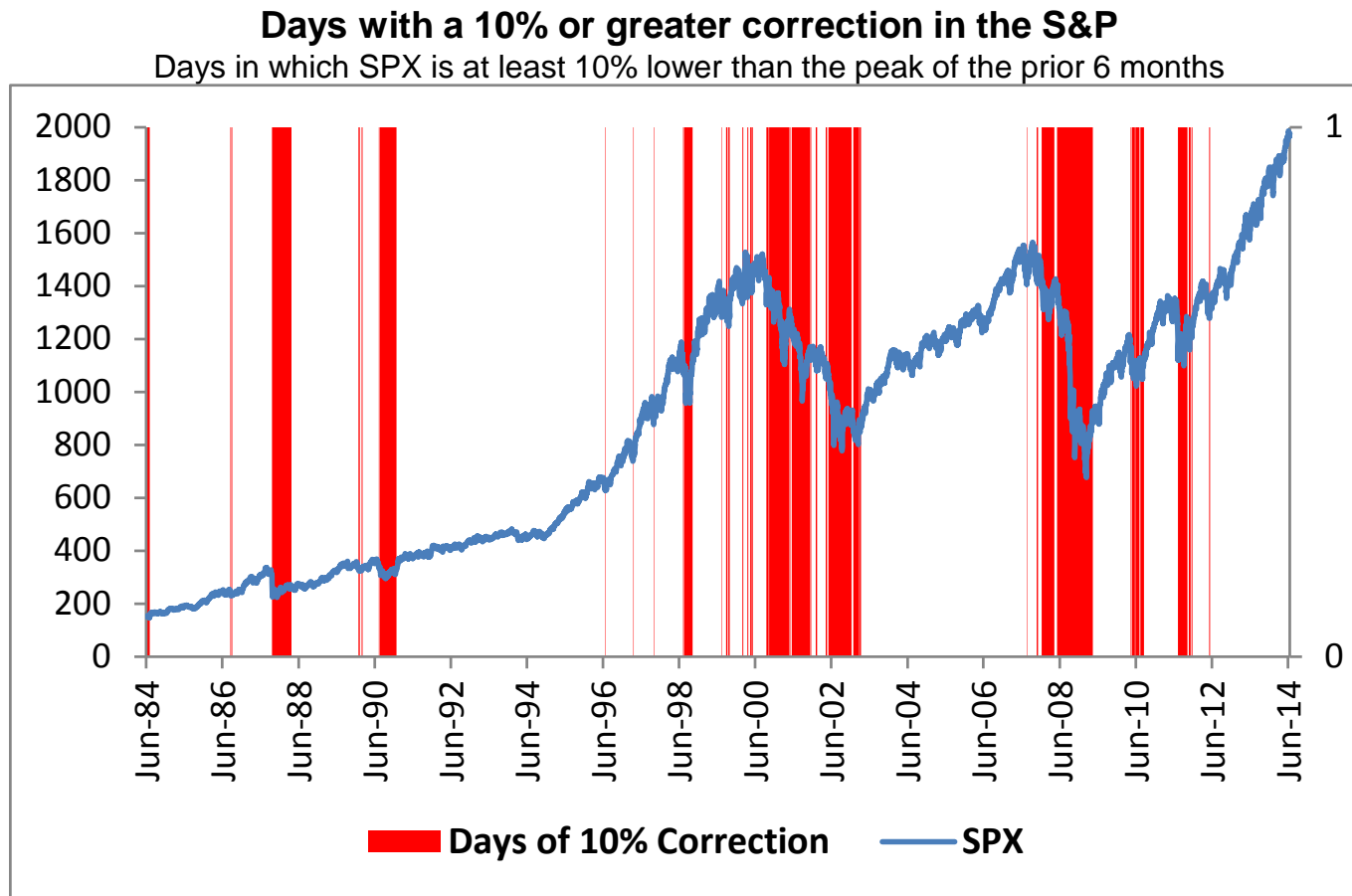
# Market complacency and excessive risk taking

Interest rate volatility can be viewed as a proxy for the corporate bond market and the interest rate at which people and companies borrow money.

Shown below is 1y10y interest rate vol with 5yr spreads of the credit default index of investment grade on the left and high yield on the left.



# Market complacency and excessive risk taking

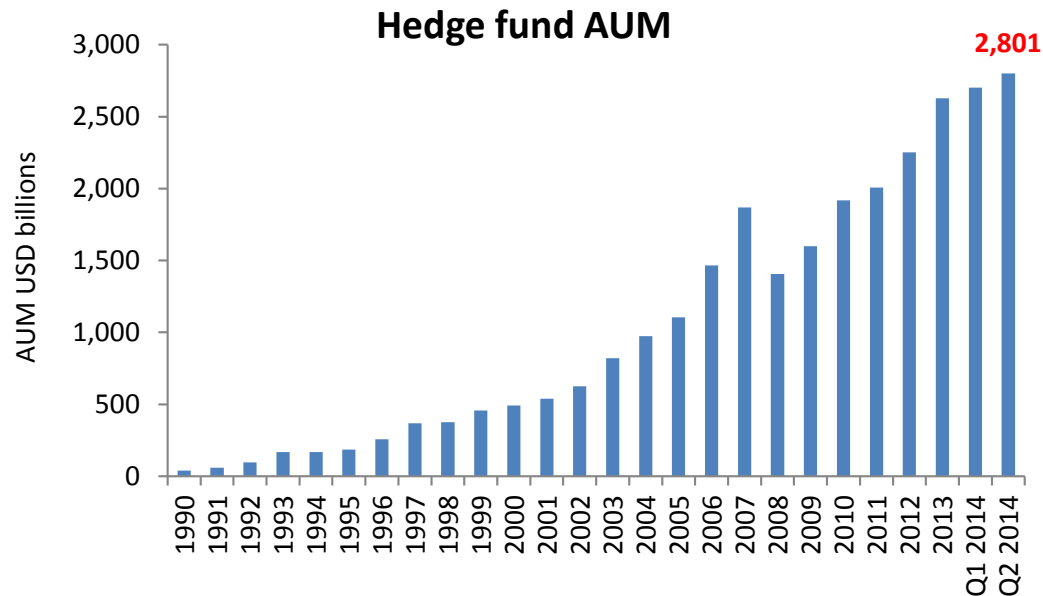


Note the lack of 10% corrections during the past hiking cycles in 2004 and 1994

# Market complacency and excessive risk taking

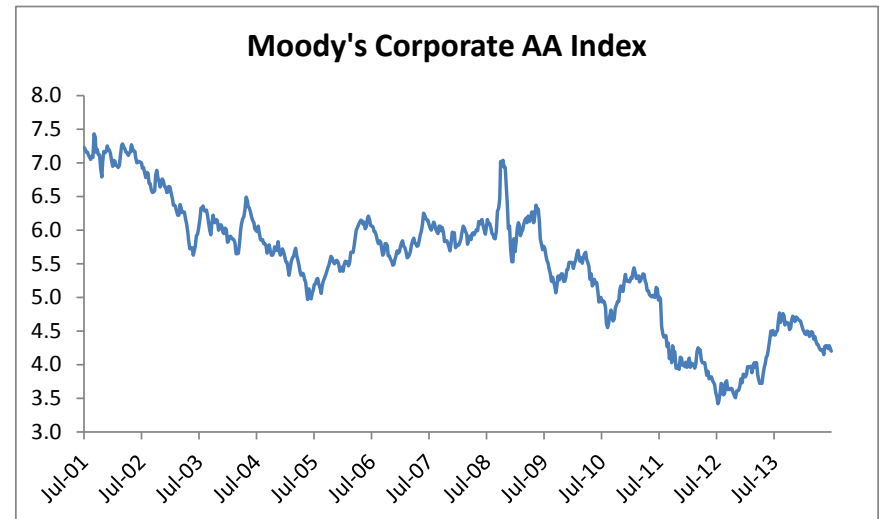
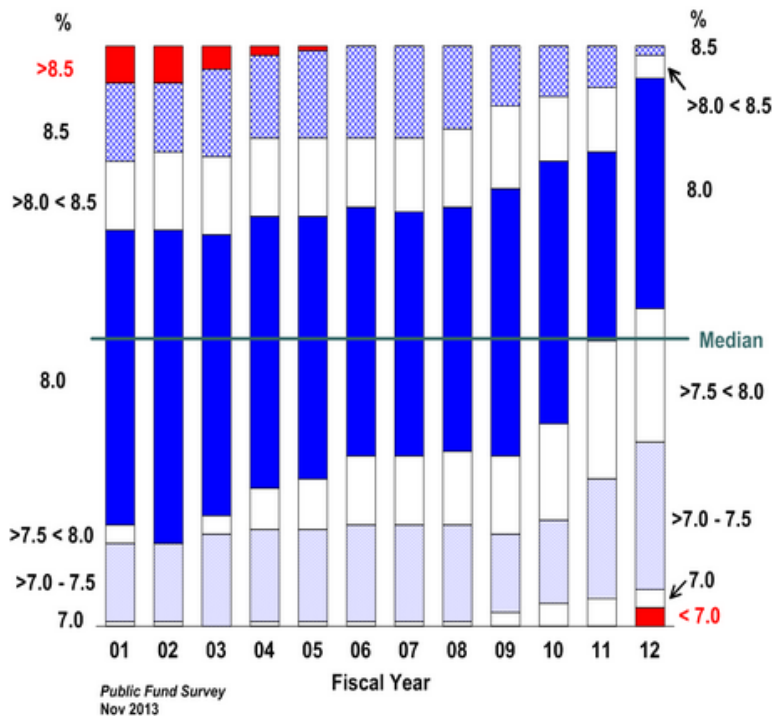
Against environment of low vol and low returns, the only way to achieve the same return targets is to take on more risk

- Ballooning AUM invested in hedge funds, now \$2.7 trillion
- VAR-based risk management frameworks and risk-parity investment models in which volatility is an input that determines the amount of risk to take

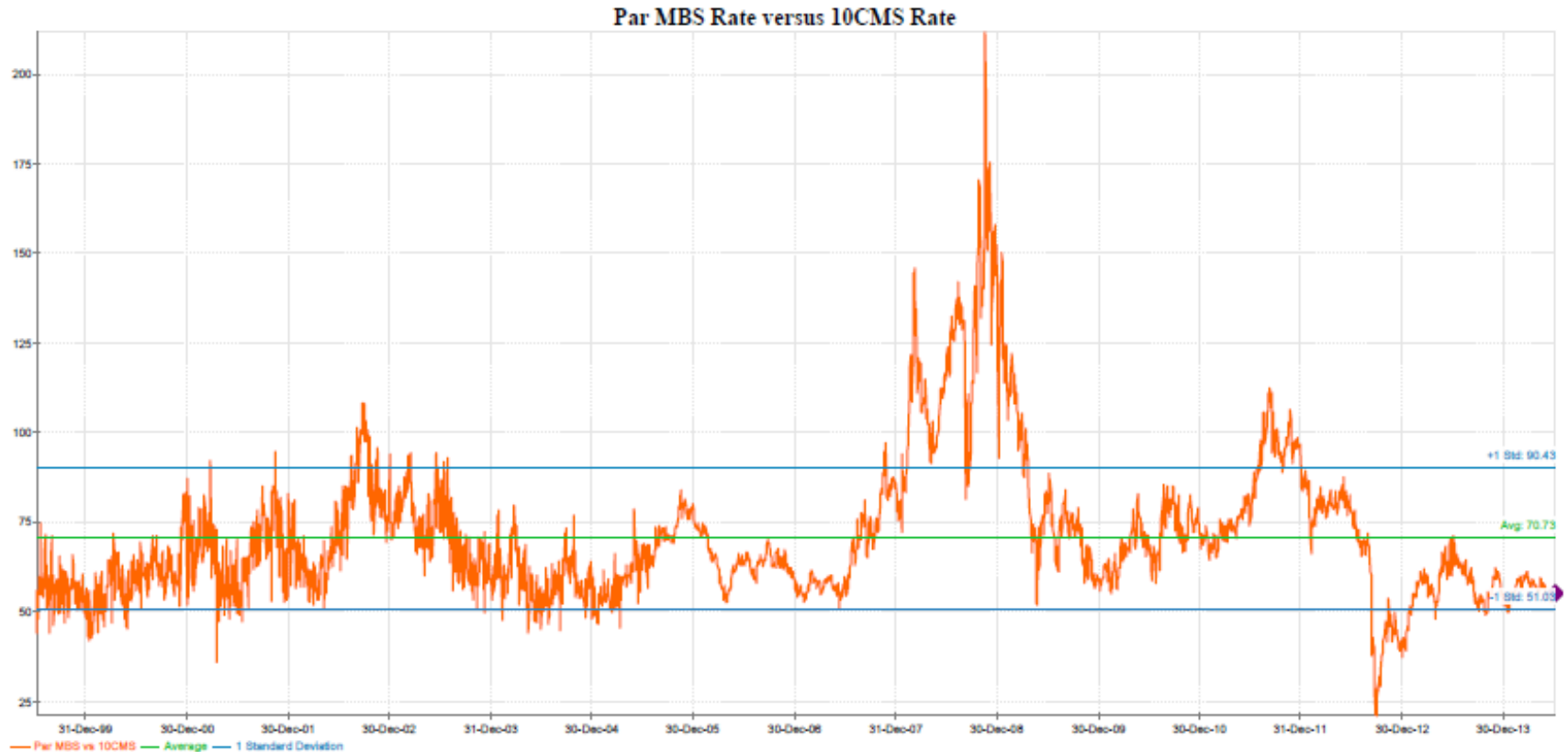


# Market complacency and excessive risk taking

Mostly unchanged target for investment returns from the pension community. Latest data from November 2013 shows the median target shifted to just under 8% in 2012, despite the yield on Moody's AA index having fallen to 4.2%.



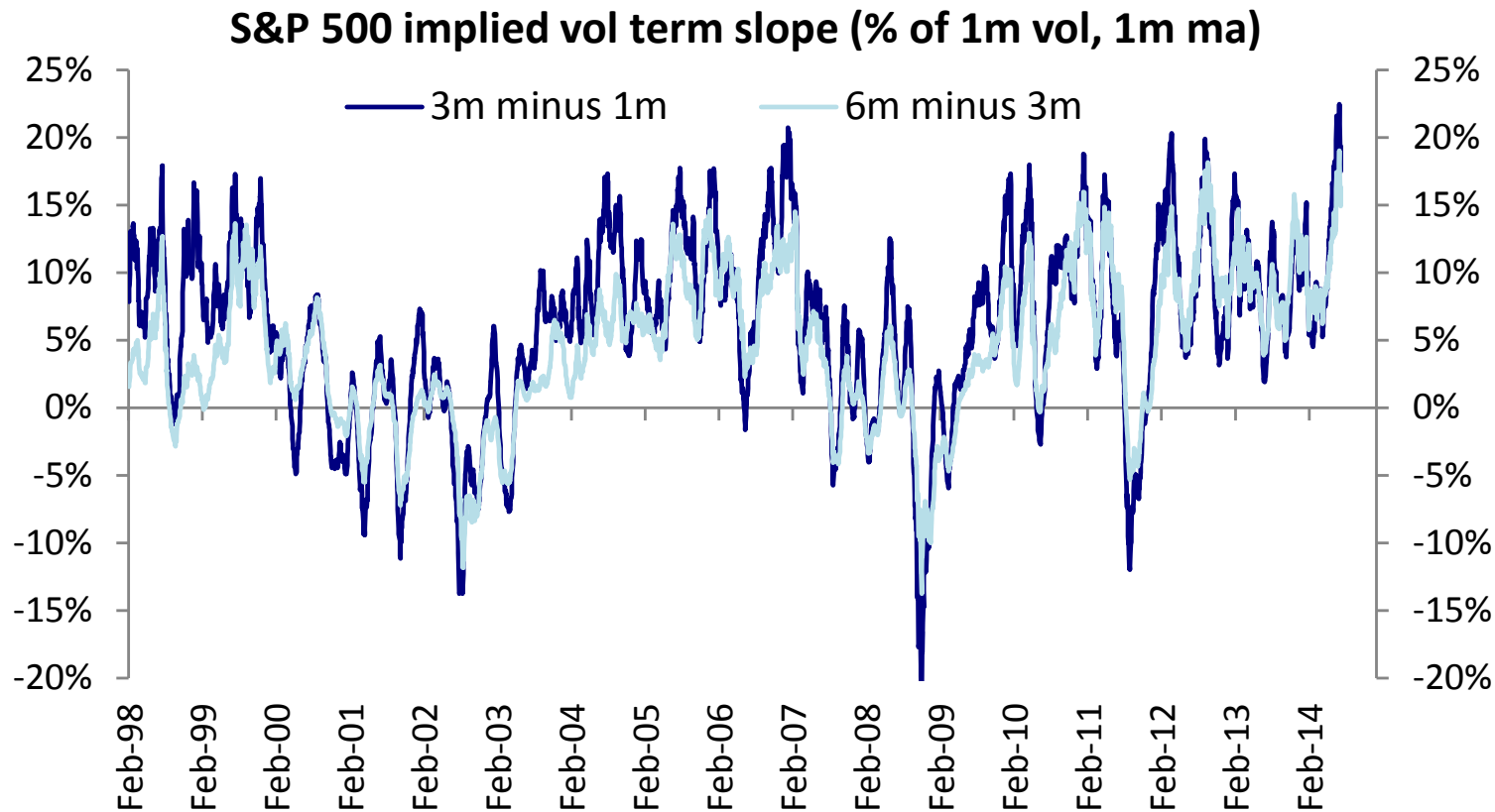
# Financial market indicators of excessive risk taking



This represents the extra yield of owning pass-thru mortgage securities from the option value without embedded prepayment assumptions.

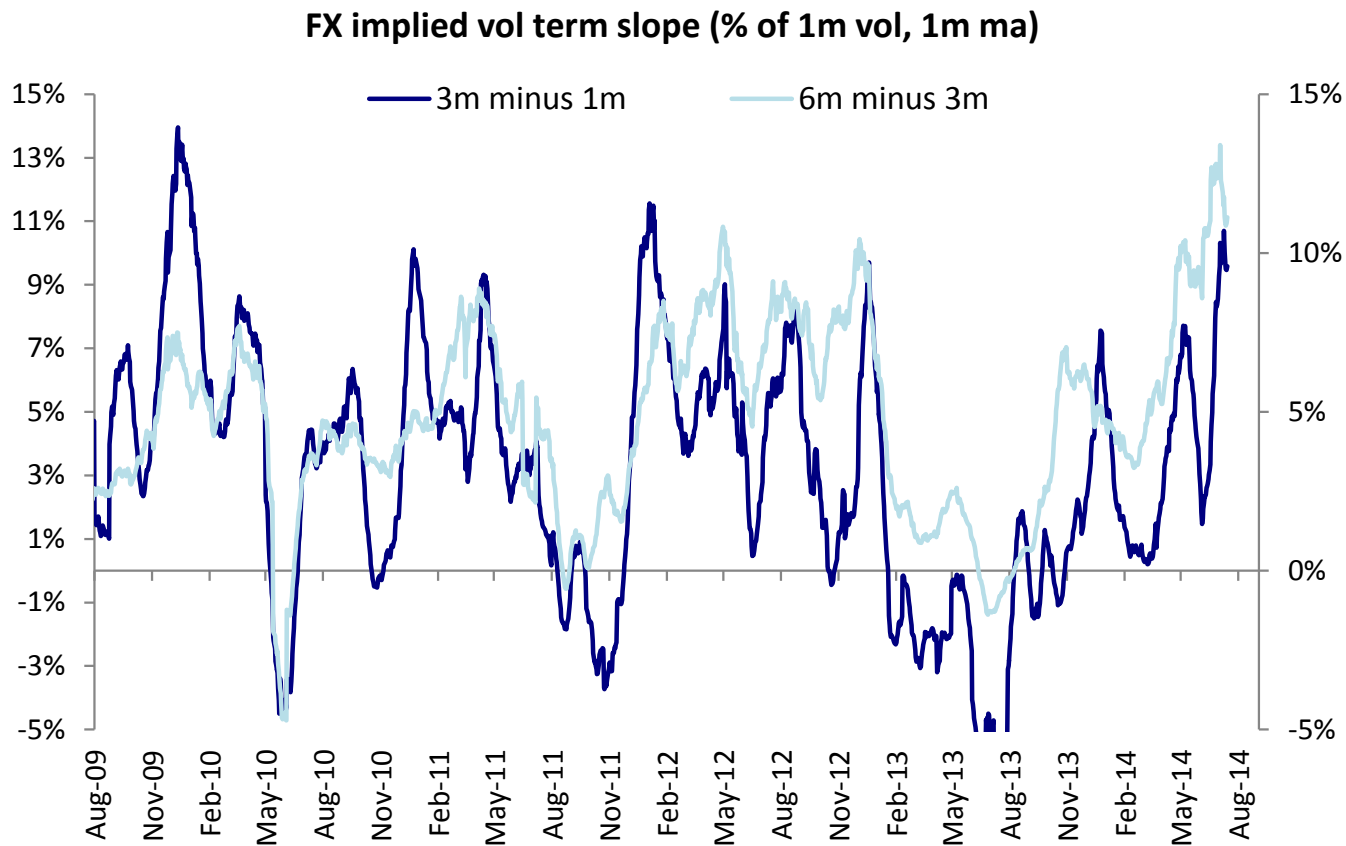


## Financial market indicators of excessive risk taking



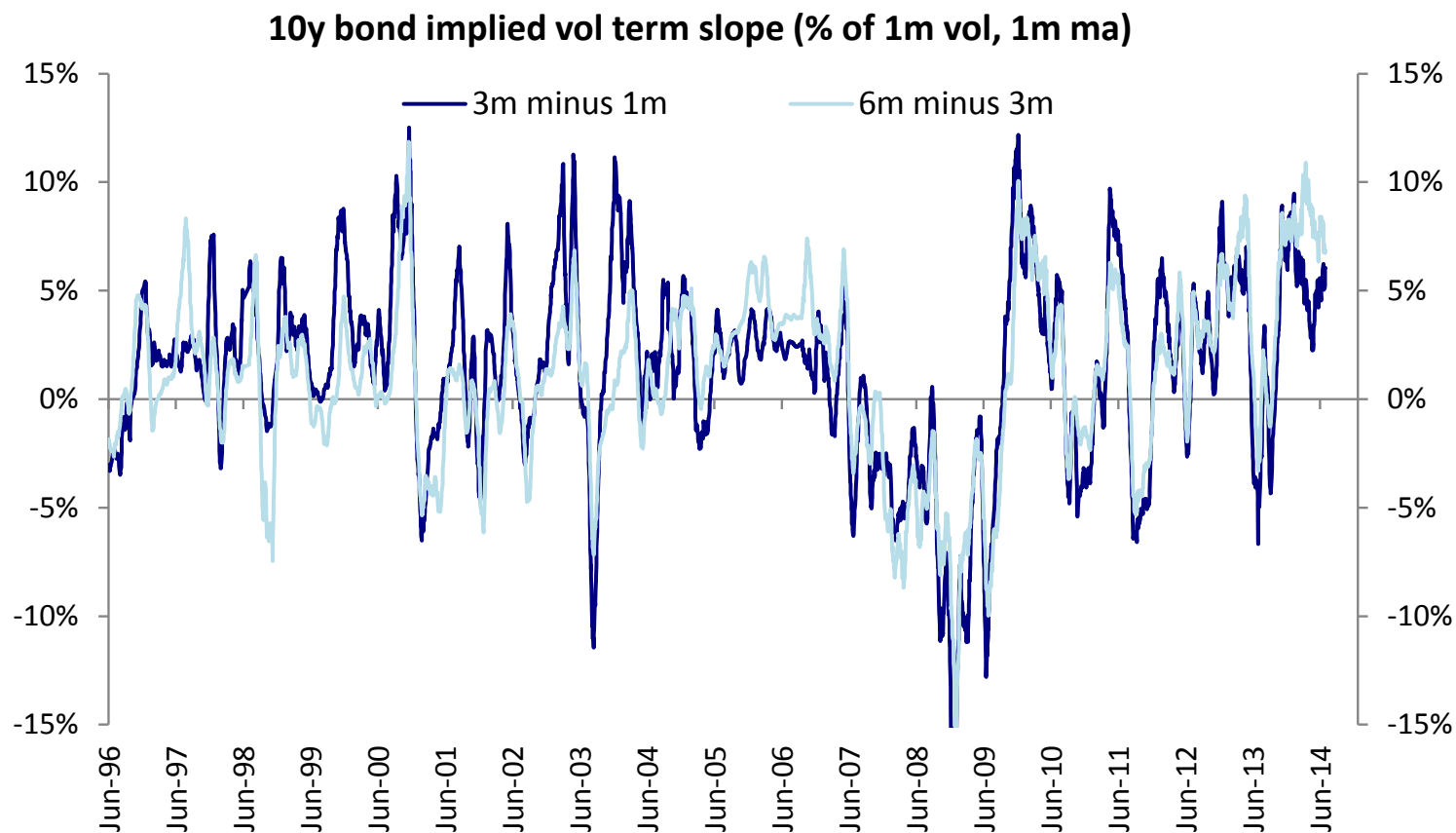
Equity vol term structure has held up against complacency in the market place.

# Financial market indicators of excessive risk taking



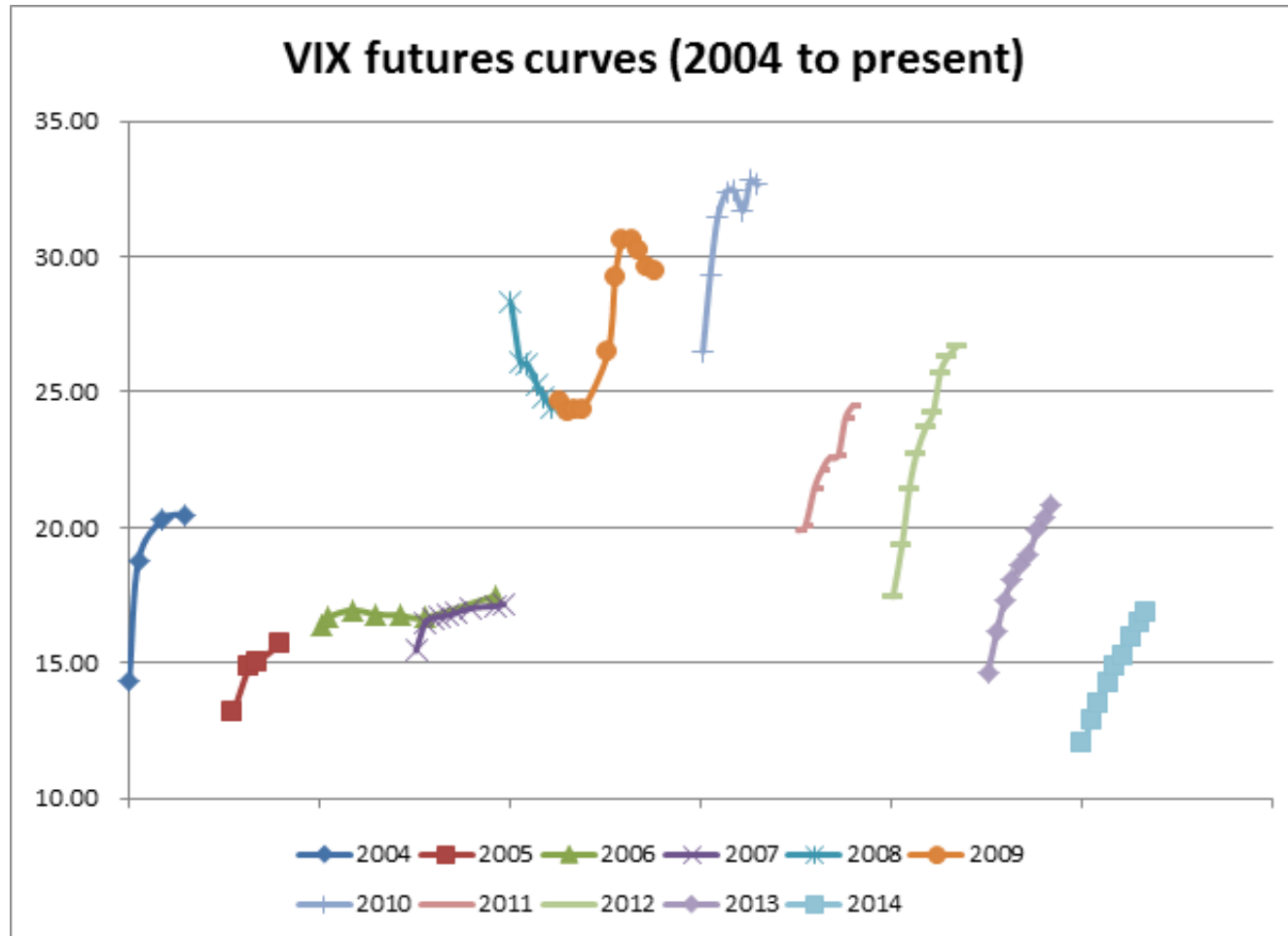
FX vol term structure is also near the steepest level in the last 5 years.

# Financial market indicators of excessive risk taking

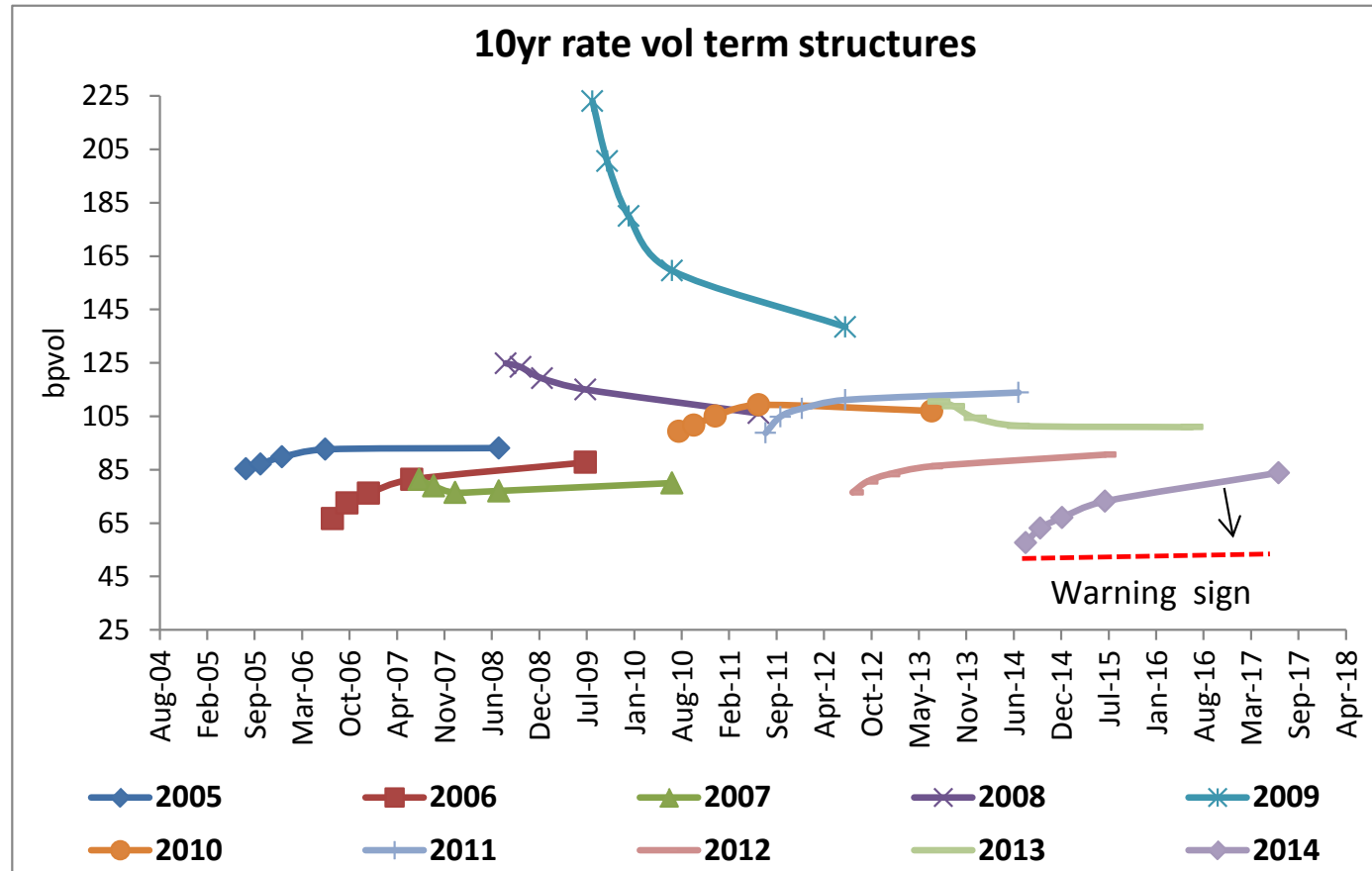


Rate vol term structure is off the highs despite the Fed being closer to tightening than at any other point in the last 5 years.

## Equity volatility term structures



# Interest rate volatility term structures



# Liquidity providers

Less warehouses for risk = higher storage costs



# Conclusions

- Monetary policy and regulatory changes have contributed to the decline in volatility.
- Less demand for volatility across asset classes naturally lowers the price for such insurance.
- VAR-based analysis leads to self-reinforcing loops as low volatility causes models to recommend scaling up risk.
- The term structure of volatility is a powerful indicator; flatter vol curves would suggest excessive complacency and presage increasing risk.
- Volatility tends to rise mid-to-late stage of the business cycle as expansive endeavors increase through the system.
- An unexpected increase in volatility might come from broad-based selling of assets wanting to de-risk in front of a turn in policy.
- With liquidity providers having declined in number and capacity, the system is less able to deal with such episodes of higher volatility. Institutions which deliver absolute returns or provide liquidity to the system would be most at risk.

## Reference

- P6: Consensus Economics, UBS
- P7: Bank of America Merrill Lynch
- P8: Haver, Deutsche Bank
- P11: Citibank
- P14: HFR Global Hedge Fund Industry Report
- P15: Public Fund Survey
- P17: Deutsche Bank
- P18: Deutsche Bank. FX vol is computed on the currencies that make up the Deutsche Bank Currency Volatility Index.
- P19: Deutsche Bank