Macroeconomic conditions and equity market volatility

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UNDERSTANDING ECONOMICS...

UNEMPLOYMENT'S DOWN...

THAT'S GOOD

NO, APPARENTLY THAT'S BAD...

IT MEANS A LABOUR SHORTAGE

THAT'S BAD

NO, THAT'S GOOD...

IT WILL PUSH WAGES UP...

THAT'S GOOD

NO, THAT'S BAD...

IT MEANS HIGHER INTEREST RATES

THAT'S BAD

NO, THAT'S GOOD...

IT STRENGTHENS THE DOLLAR

THAT'S GOOD

NO, THAT'S BAD...

MORE EXPENSIVE EXPORTS

THAT'S BAD

NO, THAT'S GOOD....

CHEAPER IMPORTS

THAT'S BAD

LET'S STICK TO THE WEATHER
Overview

• Much of the volatility of the last six months has been driven by concerns about the business cycle turning

• I’ll focus on the links between macroeconomic conditions and equity market volatility in the US
  - overall levels of market volatility
  - large-cap versus small-cap volatility
  - relative volatility levels across sectors

• What might we reasonably expect in terms of patterns in equity market volatility over the next year?
  - If we have a stabilization in data? A mild recession? A severe recession?

• Long view of data over 50 years of business cycle dynamics
Why do we care?

• Risk managers
  o indicating when implied volatility and/or trailing realized volatility are not fully pricing in macroeconomic risk

• Volatility traders
  o establishing trading ranges for rich/cheap volatility in the medium term, either directionally, or relative value trades on size / sector / style
Macro data is noisy and easy to cherry-pick… Robust predictive approaches involve smart data aggregation

We use machine learning techniques to filter out noise and to combine a large number of data series into a macroeconomic conditions index for the US.

Source: FRED and Bloomberg. In the graph above, the color and thickness of the edges (lines) represent the strength of partial correlations; the nodes are colored by their clustering via an affinity propagation algorithm, and each dot’s location represents its projection into 2D space using nonlinear manifold learning for dimensionality reduction. The first factor identified by the manifold learning model is used to create the macro conditions index.
We forecast realized volatility patterns over the following year as a function of the current level and rate of change of macroeconomic conditions, which help indicate the state of the business cycle.
Sustained equity market volatility is often associated with economic downturns...

(Z-score for macro conditions index is inverted in the graph to illustrate tracking with realized volatility)
Current data softness similar to 1998, late 2005, or Q3 2011

Macro index level Z-score Jan ‘16 = -0.20, change Z-score Jan ‘16 = -0.55
(negative levels = weak economic data)

Z-scores of the level and change of the exponentially-weighted moving average of our proprietary macro index with a half-life of 3 months. Realized volatility is calculated using 12 overlapping months of daily log returns.
The estimated probability of recession in the next year is modestly elevated (~28%)...

Late 2011 and early 2012 showed higher probabilities of a recession ahead.

Bayesian model averaging for logit models using macro conditions index half-lives of 0.5, 1, 2, 3, 6, 9 and 12 months (e.g., average of model probabilities weighted by their estimated likelihood ratios).
Forward-looking earnings forecasts become more uncertain when macro conditions are deteriorating...

Average S&P earnings growth forecast errors are around 20% when US macro index Z-score < -0.5, compared to 5% at Z > 0... and earnings volatility contributes ~50% to S&P volatility

X axis is the exponentially-weighted moving average of our proprietary macro index with a half-life of 3 months.
Y axis is the difference between actual S&P 500 earnings per share over the next 12 months and the current earnings forecasts for that period.
Forecast earnings growth and multiple growth have similar standard deviations and are correlated at about -20%.

Source: Bloomberg, data since 1990.
Equity market volatility picks up when macroeconomic conditions are bad and getting worse quickly…

Current US economic conditions alone (ignoring international shocks) predict a ~15% volatility year ahead… but note the nonlinearity, the Jan ‘16 position is nearing a region of much steeper slope.
If economic conditions are bad and getting worse, forecasts based only on trailing volatility will tend to under-predict volatility over the next year...

Our current year-ahead forecast rises to 17% taking into account realized volatility over the previous year.
In a mild recession, the model sees 1y S&P realized volatility peaking at 22% in late 2016

...and the expected case for a more severe recessionary path is 1y volatility realizing around 30%

Three scenario paths for the US economy (in terms of our macro index Z-score)

Mean (predicted) 1-year realized volatility paths for each economic path
Small-cap volatility is more sensitive to deteriorating economic conditions than large-cap on an absolute basis

Subsequent 1y difference between RTY and SPX realized volatility vs current Z-scores of the level and change of US macro index*... current forecast ~2.8%

Nonparametric kernel density model. Data from 1978-current.
F1 is the EWMA of the level of our proprietary macro model, with a 3-month half-life.
Change in F1 is the two-month change in F1. Realized volatility is for the subsequent 1 year following the observation of macro conditions.
On a vol-adjusted basis*, small-cap volatility tends to underperform large-cap on the way into a recession but outperform in recovery and mid-cycle phases

Subsequent 1y difference between RTY and SPX realized volatility on a hedge ratio of 1 : 1.20*, diff from mean vs Z-scores of the level and change of US macro index*.

Nonparametric kernel density model. Data from 1978-current.
F1 is the EWMA of the level of our proprietary macro model, with a 3-month half-life.
Change in F1 is the change in F1. Realized volatility is for the subsequent 1 year following the observation of macro conditions.
EM economic conditions are much worse than DM; the gap is as big as been since the early ’80s debt crisis…

Historically, EM economies have not tended to lead the US; they’ve tended to react to global economic conditions driven by liquidity cycles and commodity demand in developed markets.
EM economic crises push S&P vol higher in the medium term, but impact limited without concurrent US recession...

The current EM slowdown moves forecast 1y S&P volatility into the 17% range, which is consistent with the results from incorporating US macro conditions and trailing realized volatility.

X axis (F1-US) is our proprietary macro model for the US.
Y axis (F1-EM) is a basket of EM macro models including China, India, Brazil, Mexico, Malaysia, and Turkey.
Source: IMF, data since 1967.
Different sectors have higher expected future realized volatility at different points of the economic cycle.

Dependent variable is the *hedge-ratio-adjusted* spread between sector and S&P realized volatility, 1-year ahead. X (Y) axis is sensitivity to the current level (rate of change) of macro conditions.

Two-factor linear regression model. Data from 1991-current.

Hedge-ratio adjusted spread = sector 1y realized volatility – SPX 1y realized volatility * (sector 5y realized vol-of-vol / SPX 5y realized vol-of-vol)

F1 is the EWMA of the level of our proprietary macro model, with a 3-month half-life.

Change in F1 is the two-month change in F1. Realized volatility is for the subsequent 1 year following the observation of macro conditions.
Conclusions

• Current US data alone look like a mid-cycle slowdown consistent with a 15%-realized-vol year in the S&P

• Incorporating trailing realized vol or the relatively poor EM macro conditions takes this up to 17%

• However, we are nearing a transition point where the sensitivity of volatility to deterioration of US economic conditions is much higher, so volatility convexity has a lot of value

• If this is a mid-cycle slowdown and the US holds up, expect small-cap, health care, consumer staples and utilities to realize higher volatility than average relative to the S&P

• In a recession, large-cap & financials volatility should realize particularly high on a relative basis
Some important questions I didn’t answer here

• What is the impact of market liquidity conditions on volatility? How do they interact with macroeconomic conditions?

• Can we combine economic conditions and financial market stress indicators to do a better job of forecasting medium-term volatility?

• How do we account for the possibility that external shocks (e.g., EM) are more important for US markets than they used to be?