The Bayesian Surprize

By Didier Darcet

didier.darcet@
gavekal-intelligence-software.com

TrackMacro ™ is a software tool providing equity risk signals in 40 countries

In the XVIIIth century, Thomas Bayes, an English Presbyterian minister, discovered one of the most important equations in the science of probability. He mathematically formalized the degree of belief in a proposition before and after accounting for evidence. A posterior belief is a prior belief multiplied by a "surprize index", which reads:

$$"Surprize\ Index" = \frac{\text{Likelihood of the new event given the prior belief}}{\text{Likelihood of the new event in any circumstance}}$$

This concept is at the heart of AI programming and finance modelling today. Let's see how TrackMacro approaches this question.

Quality of the Forecast

Approximately a third of the time, TrackMacro has no view on the current state of a macro factor and therefore expresses a "neutral opinion", weighted zero in the global equity risk score. The quality of the forecast, however, becomes very consistent two thirds of the time, both historically and live, as shown in the examples below.

Table1. TrackMacro forecasting results, historical and live

	ANTICIPATED POSITIVE by TrackMacro		ANTICIPATED NEGATIVE by TrackMacro		All Times	
	% of time	Return p.a.	% of time	Return p.a.	% of time	Return p.a.
WORLD TRADE						
Historical Period	47%	7,1%	20%	-2,4%	100%	3,7%
Live Period	44%	5,9%	19%	1,2%	100%	3,8%
OIL						
Historical Period	44%	7,1%	26%	-16,7%	100%	4,7%
Live Period	38%	10,6%	38%	-10,7%	100%	1,4%
US Industrial Production						
Historical Period	34%	2,4%	30%	-3,8%	100%	0,7%
Live Period	38%	2,1%	13%	-6,4%	100%	1,0%

Data: Historical from 01/2000 to 02/2018, live from 06/2015 to 02/2018

Beliefs That Are Not Revised

TrackMacro is initially founded on a limited number of structural beliefs, named "macroeconomic rules", that are not revised. The rules are proposed by Charles Gave to account for the main macro drivers of equity investment returns. Favourable factors are GDP growth, trade growth, contained inflation, abundant liquidity, growing asset prices, low volatility, cheap equity valuation, low energy cost, and competitive currency.

The inertia principle is the second unrevised belief. TrackMacro can anticipate equity risks one month forward because the underlying macro variables exhibit much longer characteristic time scales. This assertion can be proven right most of the time, using traditional trend-following techniques over long history on production, trade, inflation, liquidity etc. It, however, stresses a potential vulnerability of the system in the case of sudden shocks, such as major political events, natural disasters, or market disruptions like the short squeeze on the VIX market experienced in February 2018.

How to Measure Macro Factors

Let's take the example of trade volume. The same issues apply to production, leading indicators etc. The inertia principle deteriorates fast with publication lags, and trade volumes are published with a two to three months' lag.

The solution adopted by TrackMacro is to estimate the missing data with a statistical dispersion, thanks to previous correlations with selected market prices. The correlation envelope varies, and so the dispersion. But it helps in recalculating the probable long trend with statistical significance.

Illustration 1. Macro signal preceded by its statistical envelope
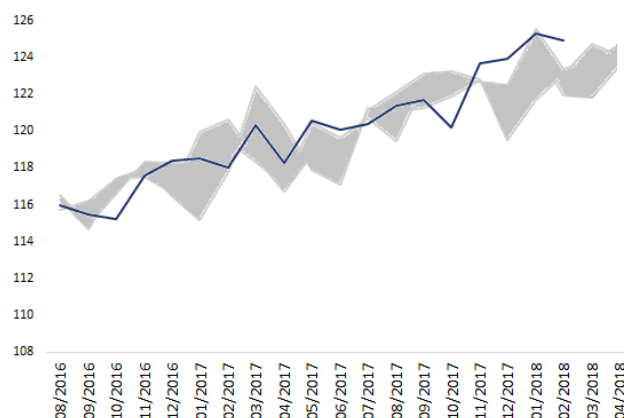
Source: Gavekal Intelligence Software

The Revision of Beliefs

Enter Mr. Bayes and his theorem. The prior "belief" is the, say, 12 months trend on world trade volume, calculated two months before. Let's assume the trend was posted strong positive, at 5.9% per annum, like today. This is the information used by market analysts to comment on the current macro situation. This isn't the one used by TrackMacro, hence endemic differences in views.

The reason lies in the new information provided by the market in the last two months. If historically correlated asset prices have fallen in the meantime, we can recalculate the likelihood of such an event, conditioned upon the prior, and divide it by the unconditional likelihood of such an event. The posterior probability of a strong 12 months trend will be affected by this "surprize index", as explained by Thomas Bayes, and the conclusion may not be positive, but negative, or simply neutral, as it is today.

Probabilistic inferences are used in science to evaluate empirical observations. They can also explain the thinking process, as suggested by cognitive sciences and computational neurosciences with the "Bayesian Brain Hypothesis". TrackMacro isn't reinventing the wheel. It's simply replicating, with emotionless algorithms, the unconscious belief revision process of a human brain.

TrackMacro's forecasting power is a Bayesian surprize.