EXAMINING THE DYNAMICS OF SHIFTING EXPECTATIONS

Blu Putnam
Chief Economist
CME Group
bluford.putnam@cmegroup.com

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Every volatility episode is unique, as the pandemic is demonstrating. Some last longer than others. Some have greater magnitude. They all have different underlying or fundamental causes. In essence, all volatility episodes are driven by the shifting nature of narratives and market expectations about the future and changing degree of confidence that market participants have in their expectations.

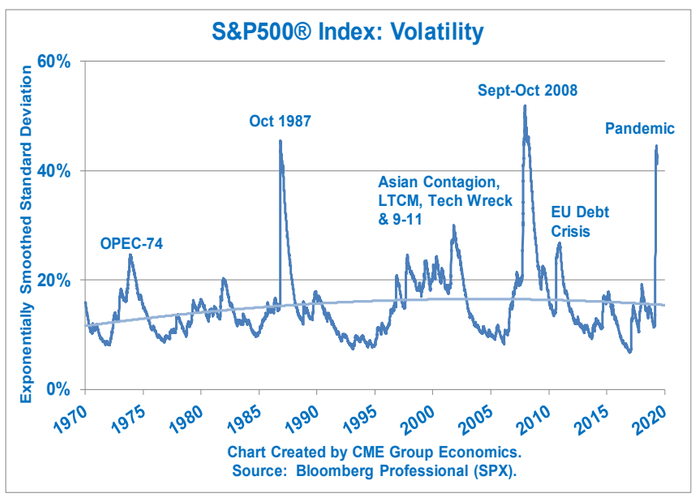
Consequently, what we want to examine are the dynamics behind the way the shift in expectations leads to volatility in the markets. That is, in this research we are not looking at the fundamental cause of a volatility episode, we are analyzing the nature and characteristics of the evolution of expectations.

To accomplish this task and to present a clear concept of the dynamics of shifting expectations, we want to link together the topics of narrative economics, Bayesian statistical inference, and quantitative market sentiment analysis.

To anticipate some of our key conclusions, our research makes the case that:

- Expectations shift because the prevailing narrative changes. What matters are the stories people are willing to internalize, to believe, and to tell to others. This is an essential concept of 'Narrative Economics'.
- Bayesian statistical inference offers a very intuitive approach to assist in adding data-driven analysis to our interpretations of narrative economics.
- Appreciating that market sentiment plays a large role and that expectations in a volatility episode are typically not normally distributed, we present some of our research on developing quantitative tools to measure and assess risk distributions as market sentiment shifts from one environmental state to another.

Fig 1 - Equity Volatility Episodes



Narrative Economics and Market Expectations

From our perspective, the key to understanding market volatility is to appreciate that it is about the narrative, and the narrative often evolves rapidly as we sort through an irregular stream of news and noise.

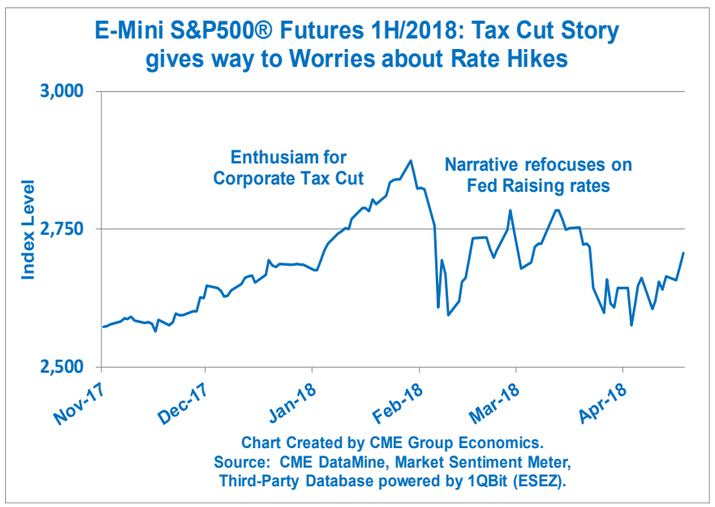
The School of Narrative Economics, led by Nobel Prize winner Robert Shiller (Narrative Economics, Princeton University Press, 2019), argues that expectations are not necessarily about the data. Expectations are grounded in the stories that people are willing to internalize, to believe, and to share on social media and repeat to others.

The stories that gain traction will be picked up by the main stream media and given a swift acceleration into the psychology of market participants.

More importantly, stories may change with each news cycle. The change in the narrative is what can influence how expectations shift and has large implications for understanding the twists and turns in market prices that we measure and observe as volatility. We will take a quick look at one case from the past, just to illustrate the concept, and save a few other examples for a little later when we discuss market sentiment and the pandemic of 2020.

To illustrate our concept, we travel in time to late 2017 and January 2018. Then, the narrative of interest for US equity market participants was all about corporate tax cuts, which were passed into law in December 2017. From February 2018, though, the prevailing narrative influencing US equities shifted abruptly to focus on the Federal Reserve's guidance that a sequence of rate hikes were coming. Our key takeaway is that the dynamics of the changing narrative was one of the key factors driving the rise in market volatility.

Fig 2 - S&P 1H-18 Taxes



Bayesian Inference and its Applicability to Analyzing Market Dynamics

Narrative Economics shares an interesting common intellectual thread with Bayesian inference statistical theory. With narrative economics, how the storyline changes with the arrival of new information is critical to analyzing market volatility.

Bayesian statistical processes are all about analyzing how new information both changes one's expectations of the future and one's confidence in that view. The common thread is the focus on how to update one's views by integrating new information into one's prior views, or we should say, the prior narrative.

Bayesian inference starts with two inputs. First, one develops a 'prior' hypothesis, which is essentially a view about what may happen in the future and one's confidence in that view.

This initial expectation may be based on experience, a theory, or just a naïve estimate.

If little or no data is available, a Bayesian simply makes a reasonable judgement. Second, there is a level of confidence associated with the expectations. Initial confidence levels are often very low.

Each news item or new data point allows a Bayesian to update the view and the probability the view is accurate. In the Bayesian world, having a view or expectation always comes with a probability attached so one can evaluate the likely accuracy of the expectation. Put another way, making a market forecast and not providing a level of confidence is not allowed in Bayesian statistics.

Think about building an economic model and trying to specify the parameters of the model or the coefficients to attach to the critical features or factors in the model. The Bayesian view would be that the parameters of an economic model are likely to vary through time.

Treating model parameters as time-varying puts the focus on how to incorporate new information into one's view (or model) of the economic system. Importantly, the Bayesian approach is comfortable with the common problem of a lack of data.

Bayesian statisticians can start with little to no data, develop a view based on experience or expertise and then let the new data confirm or shift the interpretation.

Consequently, when faced with a dynamically evolving narrative or with a switch from one formerly influential narrative to a newly developing one, our research preference is to develop Bayesian-inspired methods for analyzing new data so we can stay on top of the risk management challenges associated with the dynamics of changing expectations and episodically volatile markets.

Thoughts on Quantitatively Assessing Market Sentiment States

Our last line of analysis is to discuss our approach to quantifying the impact of a changing narrative on the sentiment of market participants which, in turn, may have large implications for financial risk management.

One approach is to incorporate text searches from the Internet to better track the rise and fall of narratives. We applaud this area of research as potentially extremely promising, even as we acknowledge the challenges that come from every volatility episode and every narrative being different.

Our initial approach goes in another direction and focuses on the actions market participants take as they respond to the changing narratives that shift market expectations. That is, our emphasis is on what market participants actually do, rather than on what they say, which is similar to what economists call 'revealed preference'.

Working with the quantum software company, 1QBit, we have tried to develop a quantitative approach to identifying different sentiment states for markets.

Arbitrarily, we ended up with four sentiment states: (1) 'complacent' with few worries and is relatively rare (~12%), (2) 'balanced' with a level of worry typical of a given market and is extremely common (~75%), (3) 'anxious' with a wall of worry and is relatively rare (~9%), and finally (4) 'conflicted' representing a very rare (~4%) yet extremely important to recognize sentiment state where there are two reasonably probable and very different scenarios embedded in the expectations of market participants.

We use a variety of features of market-participant activity to derive our risk probability distributions which are associated with different sentiment states.

Among others, our features include comparing put to call options volume, observing the relative calm or intensity of intra-day prices swings, comparing short-term and long-term historical volatility with current implied volatility from the options markets, etc.

One of the critical objectives of our research was to develop a quantitative method that was distribution-independent and could even represent bi-modal and other skewed distributions of price expectations that were decidedly not similar to bell-shaped curves and normal distributions.

And, while we do not explicitly incorporate Bayes' formula, we also spent considerable time thinking about how to incorporate Bayesian-inspired ideas to handle new data and improve the signal from some quite volatile and not so stable data sets.

By way of illustrating our research, which is at a very early stage, we will take a look at two cases: US-China trade tensions in 2019, and then the pandemic of 2020.

In our first sentiment example, we will study the US-China trade tensions case. Early in the spring of 2019, the trade tension news was a drumbeat of positive information flowing from both Washington and Beijing that a deal could possibly be coming soon.

Unfortunately, in late April and early May 2019, the negotiations became more acrimonious and talk of a quick deal faded. The trade narrative shifted to focus increasingly on whether there would be a deal soon or no deal at all.

This was reflected in our 'Market Sentiment Meter', which shifted to the extremely rare 'conflicted' state. The 'conflicted' state involves a bi-modal risk distribution, which we interpret to mean the narrative is weighing two very different scenarios (i.e., deal or no-deal) with the potential for shifts in the relative probabilities towards or away from one or the other scenarios with each news cycle.

Fig 3 - S&P 1H-19 Trade

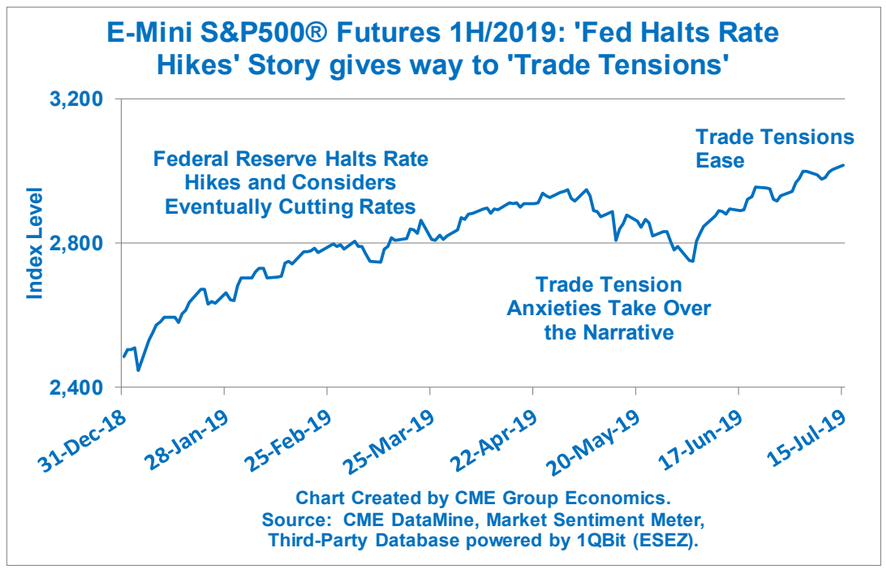
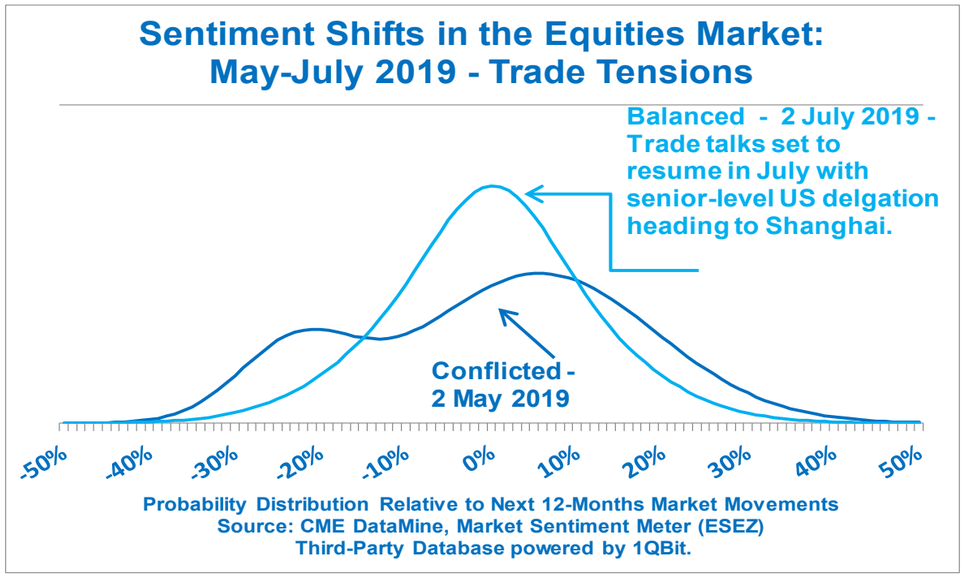


Fig 4 - Trade 19-07-02



For our second illustration, we examine interesting shifts in the narrative coming from the evolution of the pandemic. The COVID-19 virus broke onto the scene in mid-January 2020 initially as a China-only narrative. US equities reflected a 'balanced' sentiment state during the early stages when the narrative was mostly about China.

During the weekend of February 22-23, 2020, the news and the narrative shifted to a global focus, and shortly thereafter our Market Sentiment Meter showed that US equities had entered an "anxious" sentiment state, reflecting a sharp increase in worries about the future.

Then, as the narrative developed into an even more worrisome storyline, focused on the serious ramifications of shutting down travel, tourism, restaurants and bars, and generally depressing global demand for goods and services, US equity markets entered bear market territory in early March 2020.

The narrative went through several more evolutions.

Equities hit the bottom of the bear market sell-off on March 23, 2020, as the narrative shifted to reflect the degree of asset price support that the Federal Reserve (Fed) was willing to provide, with announcements of current and forthcoming purchases of US Treasuries, Mortgage-Backed Securities, Corporate bonds, and Municipal bonds.

Effectively, the Fed was promising multi-trillion-dollar support for the entire spectrum of the US fixed income marketplace. Equities rallied from their low points on the back of the "Fed has the markets back" narrative.

Fig 5 - S&P Q1-2020 COVID

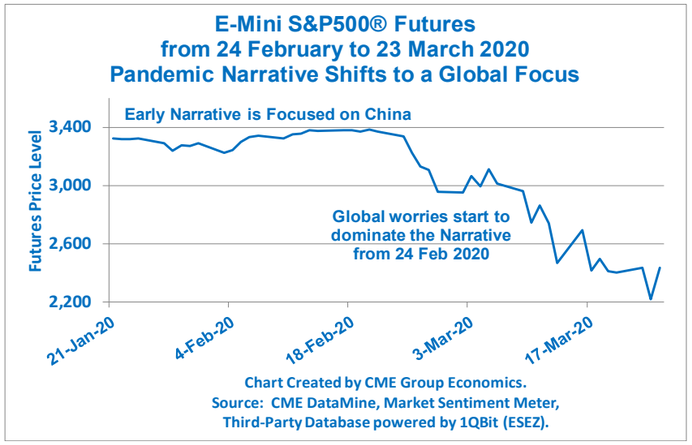
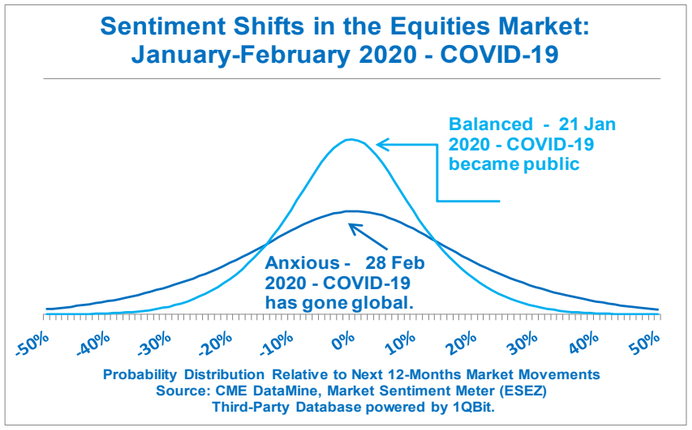


Fig 6 - Virus 20-02-28



Then, in the second half of April and into May 2020, equity markets developed competing narratives. One narrative was positively focused on economies in countries and states in the US starting to re-open their economies.

A second narrative was more pessimistic as it focused on the massive unemployment and the likelihood that further corporate layoffs, due to weak demand even as economies re-opened, would make for a very long and drawn out rebuilding phase.

The conflicting narratives suggested that while the Fed could calm the volatility in markets, there were limits to the upside on equity prices while the economy was still digesting the bad news on unemployment and the likely extremely slow path to recovery.

Work in Progress

We are careful to note that our research is not necessarily predictive. In all of our examples, anyone paying attention to equity markets would have known that sentiment had dramatically changed.

Our objective is to attempt to quantify the price expectations and the expected risk distribution, and especially to appreciate when the expected risk distribution is decidedly not bell-shaped and displays significant asymmetry or even a double-humped shape.

That is, we may all know the sentiment state has changed, but can we quantify the new sentiment state in a manner that allows for comparisons with the past, with metrics that can be inputs in risk assessment systems, and hopefully can improve our financial risk management?

We note that all of the original data, the calculated metrics, and a discreet data version of the hypothetical expected risk probability distribution is available from 2012, daily, through CME Group DataMine for eight products: E-Mini S&P, US Treasuries, Euro FX, Gold, WIT Oil, Natural Gas, Corn, and Soybeans, powered by 1QBit.

This is a storyline in development, and we hope for more improvements.

Our research to date has been illustrative and highly informative, and we think the thread of intellectual curiosity from Narrative Economics, to Bayesian-Inspired methods, to our Market Sentiment Meter, is a path worthy of future research.

Importantly, from a practical quantitative perspective, we move intellectually in a consistent manner from the interpretation of narratives in terms of their impact on market expectations to a quantitative assessment of market sentiment states which are independent of embedded distributional assumptions, may be compared to past episodes, and offer the potential to improve our risk management processes.

Fig 7- S&P 1H-20 COVID

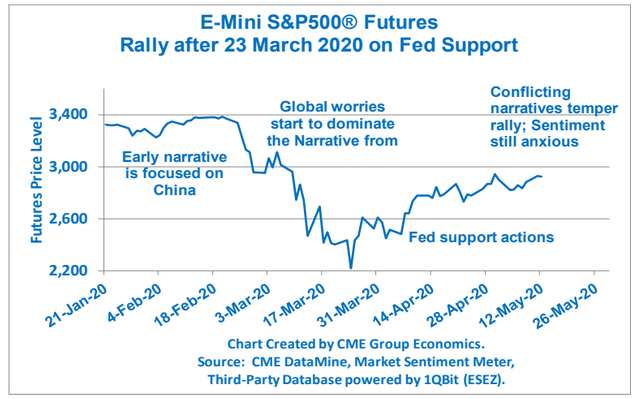


Fig 8 - Virus 20-05-2012