Physics-Based Sentiment Forecasts: Naturally Occurring Pessimism Contributed to Last Week's Selloff

August 12, 2024

JEFFREY HANSEN
www.CPMInvesting.com

From an August 5, 2024 Bloomberg article referring to stock market performance on August 4th:

> *On Wall Street, the S&P 500 had its worst day in nearly two years and the Dow Jones Industrial Average shed over 1,000 points. Shares on Japan's Nikkei Index fell by over 12% — their worst showing since Black Monday in 1987. Cryptocurrencies dropped, bond yields rose and the VIX, known as the fear index, saw its biggest one-day spike in more than 30 years. Is the Fed to blame? AI over-exuberance? Warren Buffett?* [1]

We believe naturally occurring investor pessimism contributed to last Monday's market declines. This report reviews our forecasting technique and its physics-based drivers, discusses what led to the recent conditions, and sheds light on an upcoming shift in naturally occurring investor sentiment.

[1] Gittleson, K. (2024, August 5). What's Behind the Global Market Meltdown.

Contents

We provide this three-week forecast of investor sentiment as an example of our perspective on stock market corrections and recoveries and our forecasting models.

We provide clients with multi-month forecasts and strategy sessions followed by periodic status reports.

We also offer technology transfer engagements for those wanting to make physics-based sentiment forecasts in-house.

I. Introduction to Our Forecasting Technique

Purpose: Our goal is to identify upcoming shifts in investor sentiment to enable our clients to avoid stock market losses. We use our physics-based drivers to forecast naturally occurring shifts in collective investor optimism and pessimism, and, in turn, market resilience. Our drivers predict solar energy variation, independently shown to affect human emotion. These drivers do not predict news and events. Instead, they forecast likely human reaction to news and events. Naturally occurring optimism magnifies investor response to good news. Naturally occurring pessimism magnifies the response to bad news.

Focus: Our framework recognizes two broad forces affecting investor sentiment:

1. Economic forces. Economic forces shape investor views on economic conditions and market fundamentals.[2]
2. **Natural forces. Our focus is here, because**:
   a) Our physics-based drivers, which indicate expected shifts in solar energy variation, are statistically significant in explaining the variability of sentiment-related metrics for major stock indexes. When combined, the drivers typically explain over 70% of sentiment metric variability. This report focuses on a widely used measure of price momentum, the 14-week Relative Strength Index (RSI). It also references our own Market Resilience Indexes® (MRI).[3]
   b) As implausible as this sounds, independent research supports a connection between solar energy variation and human emotion. A 2003 working paper by the Federal Reserve Bank of Atlanta concluded that solar energy variation has a significant impact on investor emotion and stock returns.

[2] For convenience, we consider behavioral patterns to be economic forces. Individuals seek to maximize economic gain and minimize regret.

[3] Our Market Resilience Indexes® are described in the Notes section on page 5.

c) Making long-term forecasts of natural shifts in investor emotion and sentiment can be done more systematically, reliably, and easily than predicting future economic forces.

Monitoring the Gap: We can get a more accurate assessment of investor reaction to economic forces by stripping away the effects of the naturally occurring forces. We monitor the gap between the actual and predicted sentiment metrics on a regular basis to estimate "excess sentiment" likely related to economic forces. Since the predicted values reflect only the natural forces and the actual values reflect both natural and economic forces, we can infer the strength and direction of the economic forces from the difference between the two.

Sentiment Metric and Timeframe	Focus	Actual Values Reflect	Predicted Values Reflect
Relative Strength Index (RSI) 14-weeks	Price change	Economic forces + Natural forces	Natural forces only
Market Resilience Index (MRI) Micro MRI – several weeks Macro MRI – several quarters	Return change		

A positive gap between the actual and predicted metrics suggests positive economics-related sentiment. A small or negative gap suggests negative economics-related sentiment.

Using Physics-Based Drivers to Predict Sentiment Metrics for Market Indexes:

1. Each predicted sentiment metric (e.g., predicted RSI) is a composite of five to ten of our physics-based drivers, with each driver predicting a specific track of solar energy variation.
2. Individual drivers are selected based on their statistical significance in explaining the historical variation of the sentiment metric over an index's entire price history through 2023.
3. The selected drivers are weighted in the composite based on linear regression models.
4. We develop the drivers and calculate their future values using data from the National Aeronautics and Space Administration, Sodankyla Geophysical Observatory, and the GFZ German Research Centre for Geosciences.

Early Warning: Considering the framework described above, an important early indicator of an upcoming market correction is when two conditions are met. First and most important, the predicted sentiment metric (e.g., predicted RSI) trends down signaling an upcoming period of vulnerability.

Second, the actual metric (e.g., actual RSI) begins to converge with the predicted values. As convergence develops, it suggests that active traders are becoming affected more by natural emotional shifts and less by economic forces. Convergence also suggests that there is little positive sentiment over and above what is expected from naturally occurring forces. This results in minimal positive economic sentiment to mitigate the negative trend associated with the first condition. Together, these two conditions mean that investors will likely overreact to bad news.

II. Discussion of Current Conditions

The US stock market met these conditions over the last several months. We communicated to our clients on June 19th that the stock market would be naturally vulnerable from mid-July through mid-August. We stated in a public blog post in early July that vulnerability could be expected through mid-August. Regarding convergence, we communicated to clients on May 22nd that the actual sentiment

metrics were converging with the paths of their predicted values, suggesting that economics-based sentiment was neutral at best.

Thus, we have expected for several weeks that the stock market would have an outsized reaction to bad news, whatever bad news might occur. We reviewed these observations in a sentiment forecast report dated August 2nd (published August 4th) written for those familiar with our methodology.

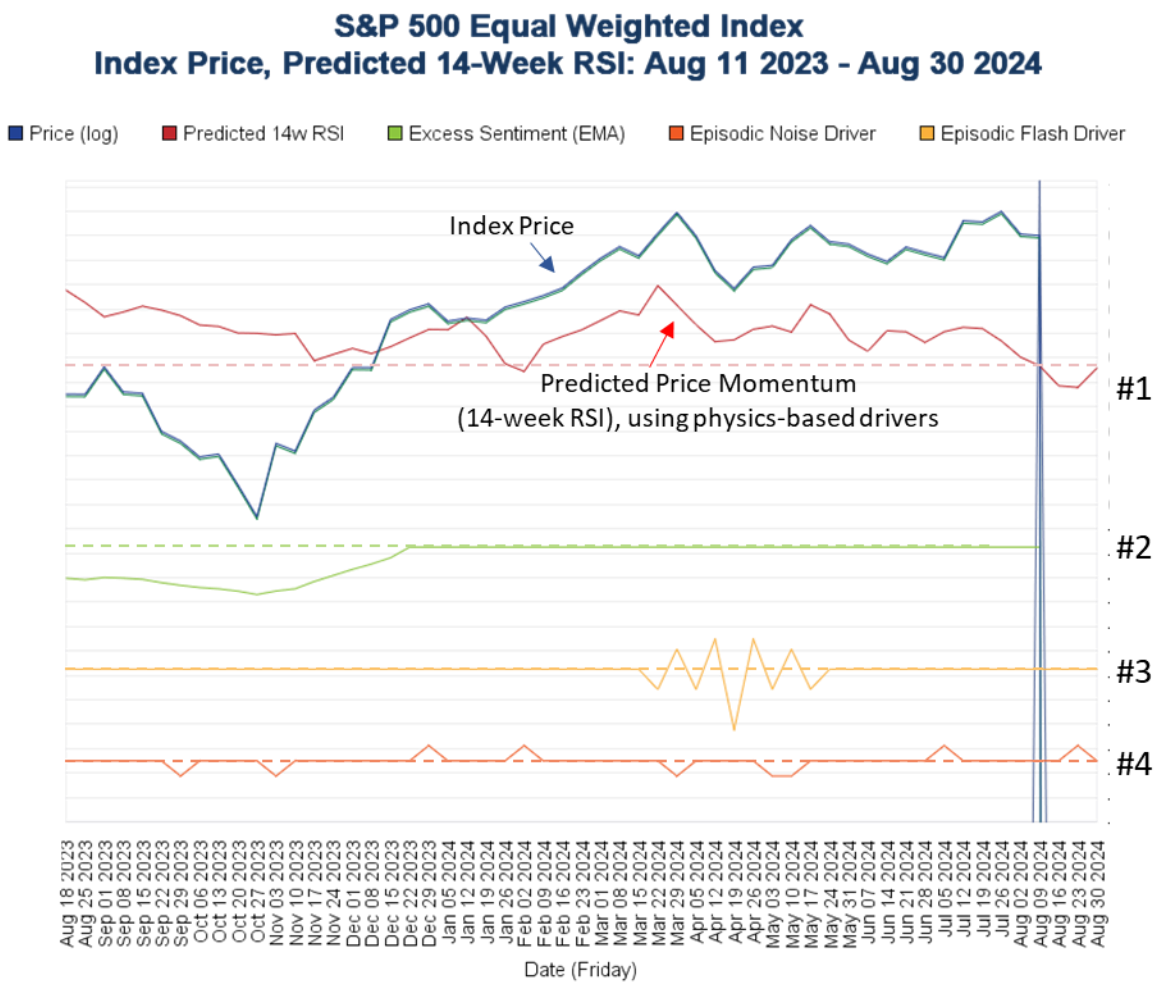
As mentioned previously, we do not forecast future economic events. For example, we did not forecast the negative jobs report for July announced on August 2nd or concerns about a possible economic recession. Rather, our forecast called for vulnerability to bad news. The August 2nd jobs report simply came at a time when there was naturally occurring vulnerability. We believe the market would have reacted more mildly to the same news had it occurred during a more naturally resilient period.

III. Looking Forward

As of this writing, the critical issues for the future are a) determining when the period of natural vulnerability will end, and b) the magnitude of the negative economic forces. Based on the three-week window of this report and as shown in the figure below, we can see two noteworthy shifts that may signal the end of natural vulnerability. First and most important, during approximately the week of August 23rd, there is a positive inflection point in the predicted RSI (line #1). This suggests a shift toward optimism will take place. Second, there is likely to be a short burst of optimism occurring in the same week, as indicated by the Episodic Noise Driver (line #4). It is important to note that these predictions may vary a week or so in either direction. If these shifts take place and affect stock market prices, many investors are likely to misinterpret the positive move as an indication that investors in general are responding to positive economic information.

Regarding the second critical issue, the magnitude of bad news is less predictable than the timing of market vulnerability. We do not assess the magnitude directly. Instead, we look at the actual readings of the sentiment metric (e.g., the RSI) a few weeks after the event to begin to assess the magnitude. Thus, there is a lag in this assessment. In addition, bad news can occur with a wide range of severity. For example, Apple earnings coming in below expectations may have a smaller impact than the Federal Reserve announcing a dramatic change in interest rates. Regardless, the importance of correctly assessing the magnitude of negative events is reduced by properly assessing naturally occurring resilience and vulnerability.

The figure below shows the last 12 months of the price levels of the S&P 500 Equal Weighted Index (heavy blue line, log scale). That line is superimposed on four lines, with each moving around its neutral line, shown as a dashed line.



Line #1 (red line) is our predicted 14-week RSI for the stock index. As discussed earlier, this series is a composite of five to ten of our physics-based drivers that are completely exogenous and independent of the stock market. It is readily apparent that, especially since late 2023, the price of the index has mirrored the directional moves of this predicted series, despite the driver representing only our predictions of solar energy variation.

Line #2 (green) represents the gap between the actual 14-week RSI (not shown[4]) and our predicted RSI. This series is a moving average of the gap, showing only noteworthy gaps. Periods with small gaps are not highlighted.[5] One can see that there was a period of negative excess sentiment prior to December 2023. Hence, we infer that investor sentiment related to economic forces was negative during that period. Since that date, none of the gaps have registered as notable, indicated by the green line being at its neutral position since December 2023.

Line #3 (yellow) shows the Episodic Flash Driver. This, along with the Episodic Noise Driver discussed below, is one of several of our physics-based drivers and is, like the other drivers, purely a predictor of

[4] A comparison of the actual RSI and the predicted RSI is shown on page 3 of our August 2, 2024 sentiment forecast report.

[5] Only gaps with a z-score greater than 0.5 are shown. The z-score is based on the tracking deviation between the actual and predicted values since 1940, substituting the DJIA for the S&P 500 Equal Weighted because the latter's short history.

solar energy variation. There is a statistically significant negative relationship over the several decades between the actual RSI for the index and the Episodic Flash Driver.

Line #4 (rose) shows the Episodic Noise Driver. While this series is not statistically significant over the 80-year test period, it is worth considering, as it appears to influence index prices on an intermittent basis. It can initiate a trend short-lived trend.

In addition to the upcoming positive shifts in the predicted RSI and the Episodic Noise Driver, there are additional forces promoting a shift from vulnerability to resilience during (approximately) the week of August 23rd. Our own Micro Market Resilience Index (not shown in the figure above) is predicted to shift to an optimistic stance.

The upcoming period of naturally occurring optimism will occur regardless of economic events and forces, and the shift may be enough to initiate a new long-term rally or a bear market rally. Yet, a move higher in the stock market is not guaranteed. Stock market investors may find that the magnitude of the negative economic forces is sufficiently large to overwhelm the naturally occurring optimistic sentiment.

While not within the three-week forecast horizon of this report, we can say that the predicted RSI does not move dramatically higher for the next several weeks beyond that horizon. Thus, if economic forces favor a rebound in stock prices, they, unfortunately, will not be supported by exceedingly strong naturally occurring optimism.

IV. Conclusion

Our models predict shifts in naturally occurring investor sentiment by utilizing physics-based drivers. The stock market has been inherently vulnerable to declines over the last few weeks and we believe this contributed to last week's stock market declines. Our forecast calls for vulnerability to continue for the next week or so. We will then see an increase in naturally occurring optimism.

This forecast is based on our physics-based drivers shown to explain 70% of market sentiment variation historically, despite being entirely exogenous to market and economic forces. Investors can better prepare for market volatility and more accurately assess investor reaction to news and events by understanding these naturally occurring shifts.

Notes

1. Two Sentiment-related Metrics

We forecast two different sentiment-related metrics. The 14-week Relative Strength Index (RSI) measures short-term price momentum for a market index based only on index prices. Positive price momentum indicates positive sentiment and market resilience. We also forecast our own Market Resilience Index® (MRI) series. The MRI measure the recent return acceleration of a stock index based only on index prices. Thus, positive sentiment can be seen in high price momentum and high market resilience. The RSI and MRI have distinctive features.

RSI

- Widely used in the investment industry
- Effective in identifying market bottoms
- Less effective in identifying market tops. RSI can peak months before the index price peaks
- A single series that is readily understood
- It represents only one timeframe. The 14-week RSI measures price momentum over approximately three months

MRI

- Designed to identify market price inflection points, both market tops and bottoms
- Different indicators for different timeframes:
    - Micro MRI – short-term shifts in resilience lasting several weeks
    - Macro MRI – longer-term shifts lasting several quarters
    - Mega MRI – long-term shifts lasting several years (not discussed in this report)

2. Over Two Dozen Physics-Based Drivers

We have developed drivers that forecast specific tracks of solar energy variation. All drivers reflect physical dimensions related to the strength of gravitational and electromagnetic forces affecting the distribution of energy emanating from the Sun. There are two types of drivers:

1. Cyclic Drivers
    - These change gradually over time
    - They tend to have greatest impact on index prices during times of economic stress
2. Episodic Drivers – Episodes with abrupt beginnings and ends in solar energy variation. The two discussed in this report:
    a. Flash - Statistically significant multi-week episodes
    b. Expected Noise – One- or two-week episodes that are intermittently meaningful