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The FRED® Blog

Measuring uncertainty and volatility with FRED data



Posted on June 24, 2021



CPI +3.2 % Chg. from Yr.
Ago on Feb 2024

Civ. Unemploy. Rate 3.9 % on Feb 2024

10-Yr. Treas. Rate 4.22 % on 2024-03-22

Real GDP +3.2 %, Comp.
Annual Rate of Chg.
on Q4 2023

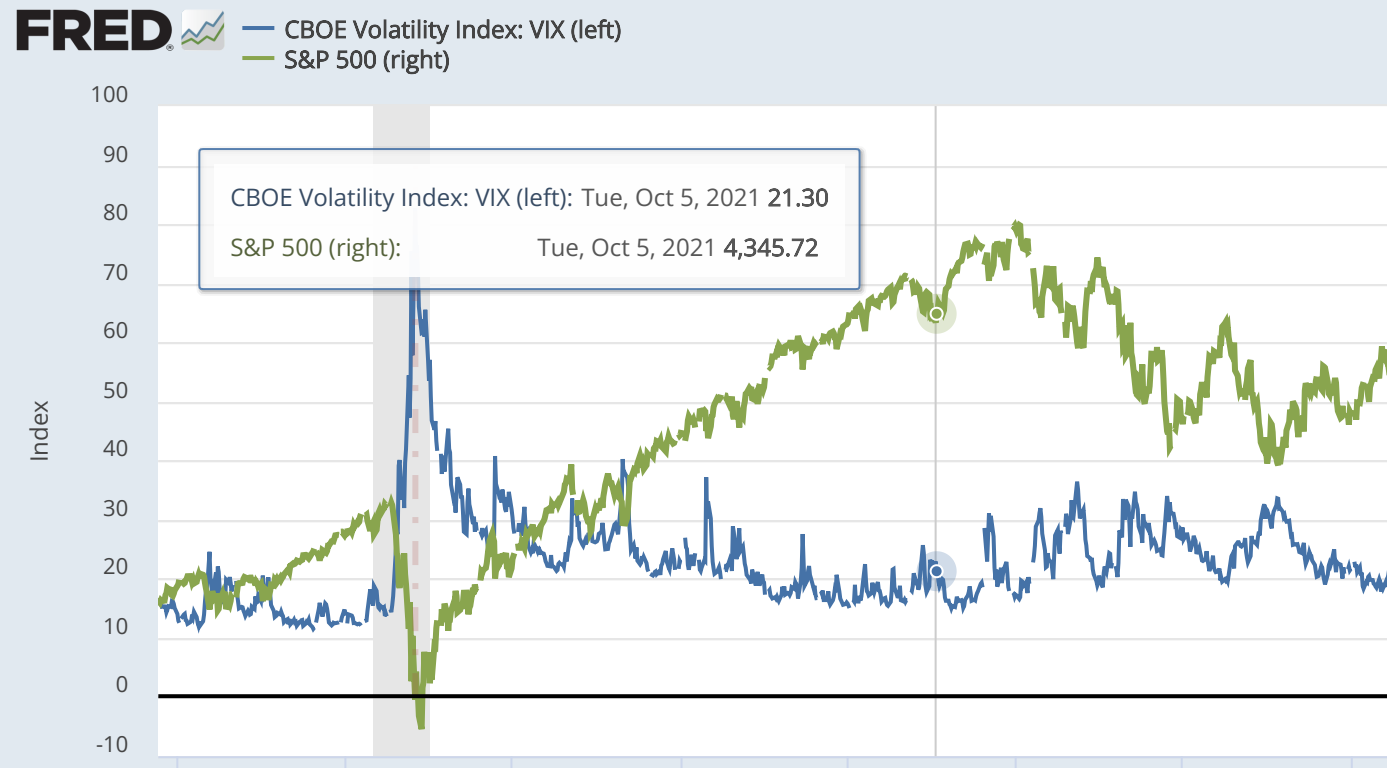
IP +0.1 % Chg.
on Feb 2024

Payroll Employment +275 Chg., Thous. of
Persons on Feb 2024

... and 823,000+ more series in FRED

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Uncertainty and volatility are closely related but distinct concepts. People are uncertain if they lack confidence in their knowledge of the state of the world or future events. News is more likely to change the views of people with high uncertainty. In financial markets, changing views is associated with changing asset prices. Volatility denotes the size of changes in asset prices, so volatility is an *ex post* (after the fact) measure of uncertainty.

Uncertainty and volatility are carefully watched variables because of their relation to financial crises. During such periods, uncertainty often rises to high levels as the prices of risky assets, such as stocks, tend to fall. This produces a short-term, negative relation between uncertainty and returns.

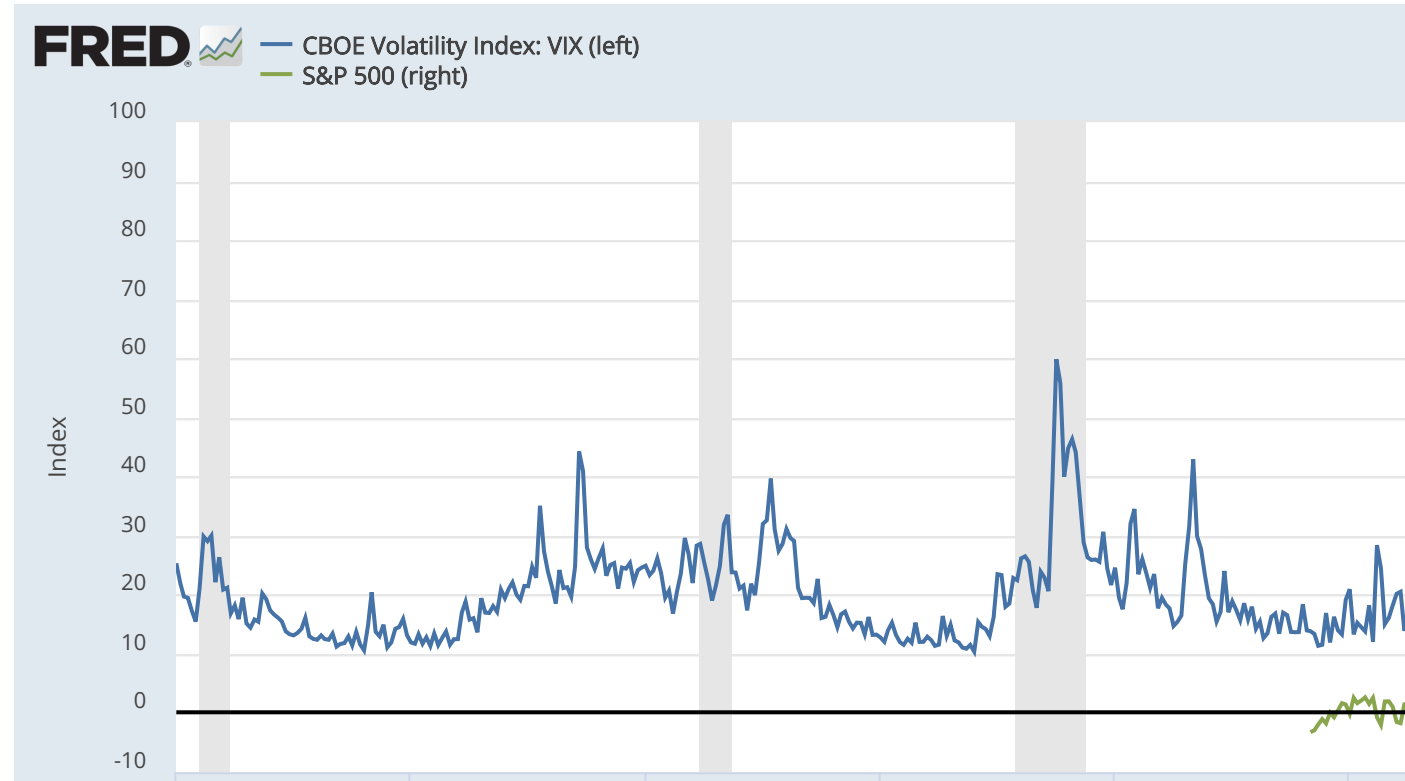
FRED has a number of series that are related to uncertainty and/or volatility, some of which are derived from options data. One of the most frequently used such series is the Chicago Board of Options Exchange (CBOE) Volatility Index, or VIX. This options-derived series predicts one-month-ahead volatility on the CBOE S&P 500 futures contract.

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Archives

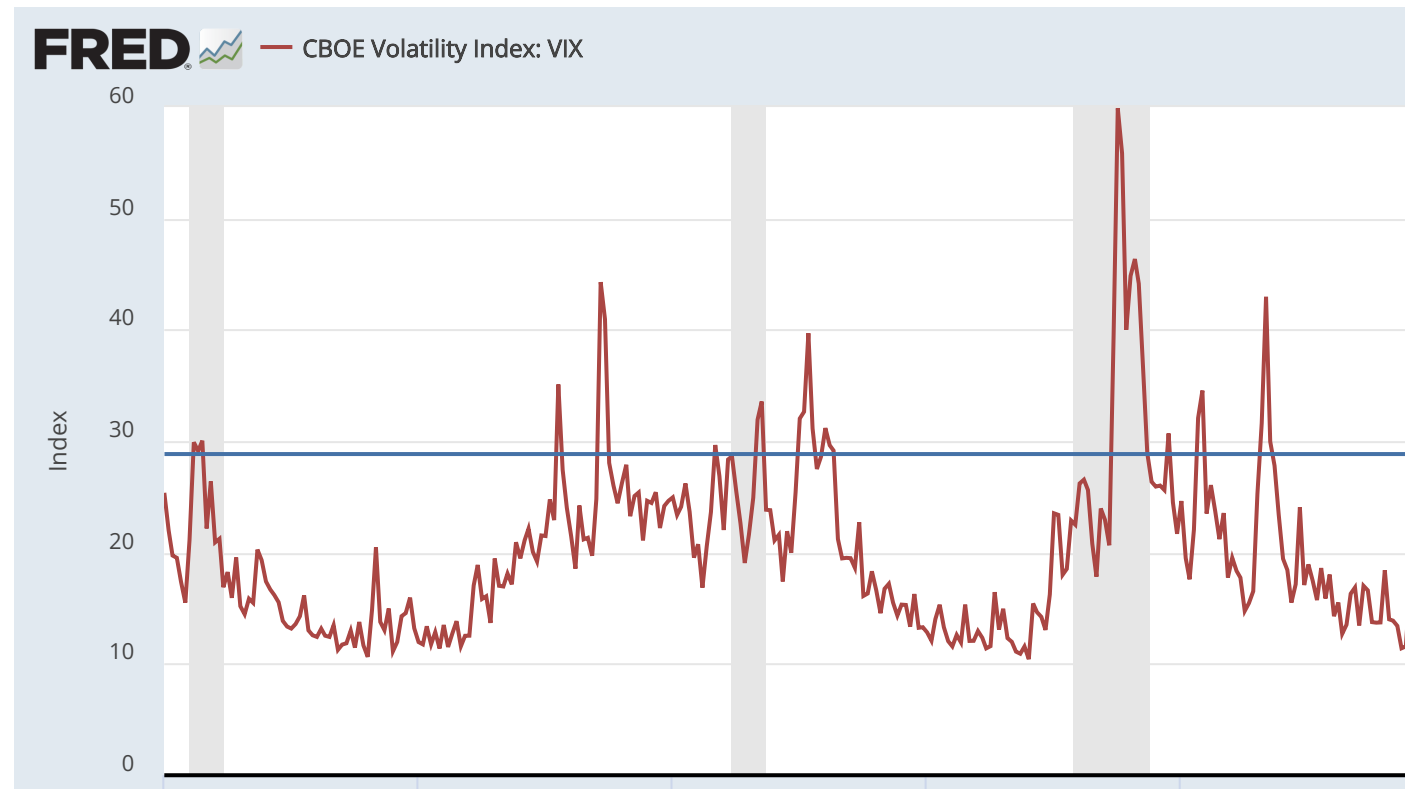
- [March 2024](#)
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- [September 2023](#)
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- [December 2021](#)
- [November 2021](#)
- [October 2021](#)

To illustrate an example of the common negative relation between uncertainty and stock returns, FRED users can employ the two-axis option to overlay a volatility index, such as VIX, with the underlying price series. In the first FRED graph at the top of the post, one can easily see how the rise in VIX coincides with the decline in S&P 500 prices during the period from mid-February to late-March 2020.



Note that if users graph a long span of daily data, such as VIX or the S&P series, FRED will automatically revert to graphing lower-frequency data instead of daily data, although the underlying series are still daily. For example, if we extend the time scale on the first graph back to 1990, FRED will revert to graphing monthly data and no longer show us the values for individual days. See the second FRED graph above.

- September 2021
- August 2021
- July 2021
- June 2021
- May 2021
- April 2021
- March 2021
- February 2021
- January 2021
- December 2020
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- July 2018



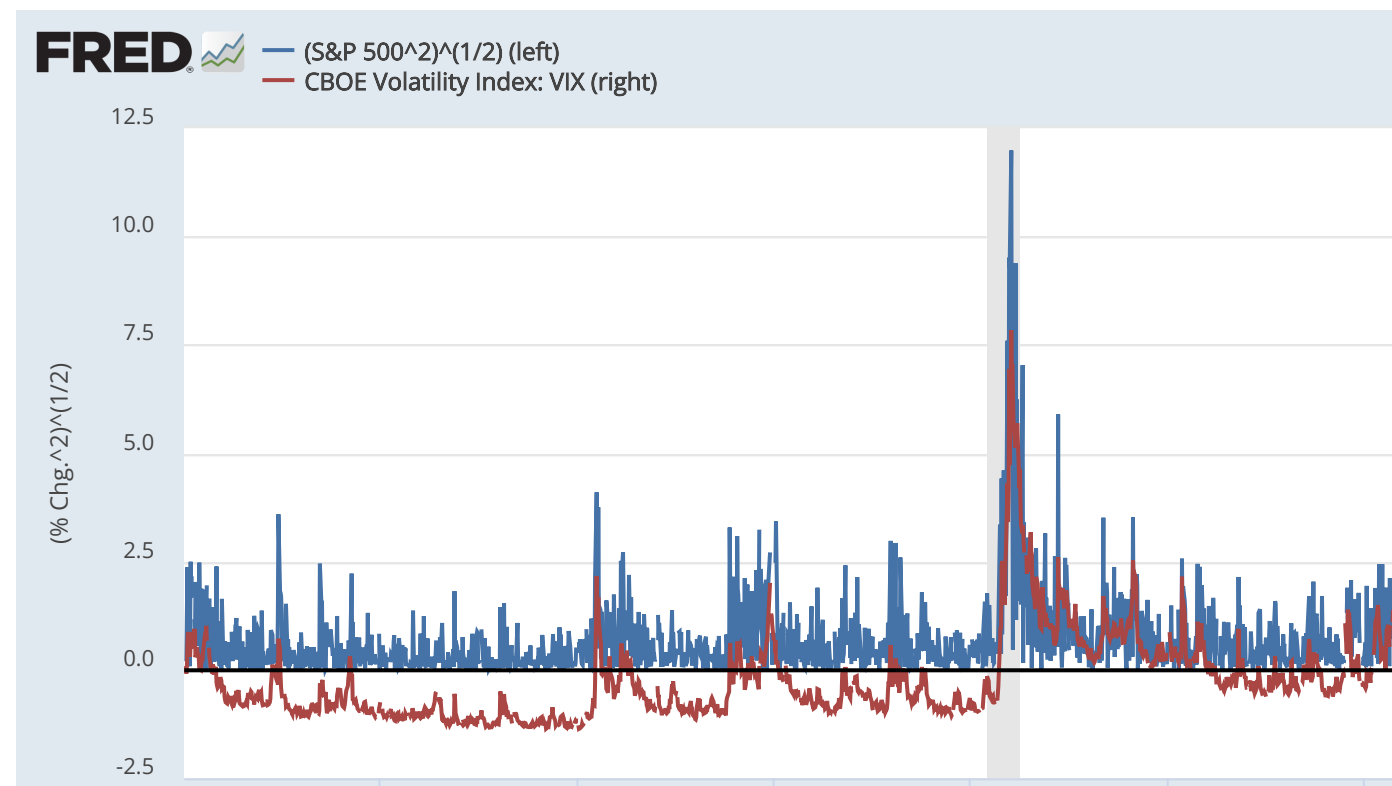
Users can define their own lines to enhance the look of their graphs. Horizontal lines can emphasize periods when uncertainty or volatility is above a certain level. One could download a series to a spreadsheet or some statistics software to find its 10th or 50th or 90th percentile and then use those percentile values to emphasize particularly high or low values. For example, in the third graph shown above, 90% of the VIX series observations are less than 28.84. By creating a line at that level, we can indicate the upper 10% of VIX observations.

Users can also create a vertical line to highlight action on dates of interest. For example, March 16, 2020, was a very volatile day for U.S. financial markets, as participants came to grips with the impact of COVID-19 and the likely policy responses. The vertical line in our very first graph draws emphasis to this date as a turning point in the financial market reaction to COVID-19.

Finally, it's possible to compare an *ex ante* (before the fact) prediction of volatility over the next month (e.g., VIX) to an *ex post* (after the fact) volatility measure that uses daily prices. To compute actual daily volatility (i.e., the absolute daily percent changes), change the units of S&P 500 prices to

- June 2018
- May 2018
- April 2018
- March 2018
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- December 2017
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- May 2017
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- July 2015
- June 2015
- May 2015
- April 2015

percent change and apply the following formula in the formula bar: $(a^2)^{(1/2)}$. *Ex post* volatility over a day need not exactly correspond to *ex ante* predictions of volatility over a month. For example, volatility may be low today but high over the next month if important news is expected to come out in a couple of weeks. Conversely, volatility might be temporarily high as important news is released but expected to decline in the near future. Still, our last graph (below) usefully illustrates the tendency of the two series to move together.



How these graphs were created:

First graph. Search FRED for “VIX” and select “CBOE Volatility Index: VIX.” The default graph will be a daily graph of VIX. Use the “edit graph” button to open the editing box. Use the “add line” tab to search for and add the daily series “S&P 500.” Use the “format” tab to shift the y-axis position of the “S&P 500” series to “right axis.” Go back to the “add line” tab to “Create user-defined line.” Click on “Create line” and type in starting and ending dates of “2020-03-16” and starting and ending values of 0 and 90. This will produce a vertical line on 2020-03-16. You can change the line style, width, and

- [March 2015](#)
- [February 2015](#)
- [January 2015](#)
- [December 2014](#)
- [November 2014](#)
- [October 2014](#)
- [September 2014](#)
- [August 2014](#)
- [July 2014](#)
- [June 2014](#)
- [May 2014](#)
- [April 2014](#)
- [March 2014](#)

color from the format tab. Returning to the main graph, use the date range boxes to set the beginning date to “2019-06-10.”

Second graph. From the first graph, change the beginning date to “1990-01-02” using the date range boxes.

Third graph. Search FRED for “VIX” and select “CBOE Volatility Index: VIX.” Use the date range boxes to set the beginning date to “1990-01-02”. Use the “download” button to download the series to an Excel file. Once you have opened the file, type:

=PERCENTILE.EXC(IF(ISNUMBER(B13:B8214),B13:B8214),0.9) in an empty cell (cell range will be different from when this was written). This returns the 90th percentile of the VIX data (i.e., 28.84). Back to the graph, use the “edit graph” button, go to the “add line” tab to “Create user-defined line.” Set the starting and ending values for the line to “28.84.”

Fourth graph. Search FRED for “S&P.” The default graph will be a daily graph of the S&P 500 for the past 5 years. Click the “edit graph” button and select the units for the S&P 500 as “Percent Change” and the formula as $(a^2)^{(1/2)}$. Click on “add line” and search for “VIX”. “Select the daily “CBOE Volatility Index: VIX”. Select “Add data series.” Select the units as “Index,” not percent change. Using the format tab, select “Right” for the y-axis position of “CBOE volatility Index: VIX” series. Close the editing box. Using the date range boxes for the graph, select a 5-year date range.

Suggested by [Christopher Neely](#).

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