

Effects of Coronavirus on S&P Realized Volatility

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1 Motivation

After the Coronavirus pandemic spread to the United States, there was an understandable drop in the United States stock market. Also during this time it became apparent that even small pieces of news had the potential to cause large fluctuations in the market. For example, after the biotech company Moderna released clinical trial results for its preliminary vaccine, the SP increased by 3 percent the same day. It would be difficult to prove direct causation, but regardless it does seem like the stock market is more volatile now than it was before the Coronavirus.

The purpose of this study was to quantify the effect Coronavirus had on the realized volatility of the S&P, and also explore the realized volatility during past presidential terms.

2 Method

In order to quantify the effects Coronavirus had on the market, I first needed a method of calculating the volatility of a stock over time. The most granular data I had access to was the minute prices of the S&P. As a result, I calculated realized volatility by taking a rolling standard deviation over a 20 minute window on the geometric returns of the S&P. (Note: the values of realized volatility have the same scaling as the minute geometric returns of the S&P)

3 Results

3.1 Effects of Coronavirus on the S&P

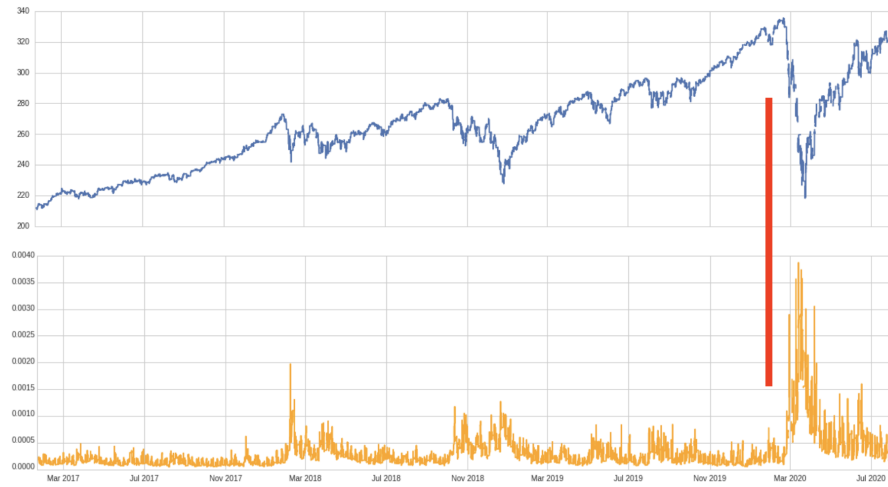


Figure 1: Graph of historical S&P stock price (blue) and realized volatility (orange) during Trump's term. The red bar indicates the beginning of the pandemic.

It is apparent that there was a definite change in the distribution of realized volatility after the pandemic began. Figures 2 and 3 show the historical index price and realized volatility of the periods of President Trump's term before and after the pandemic began, respectively.

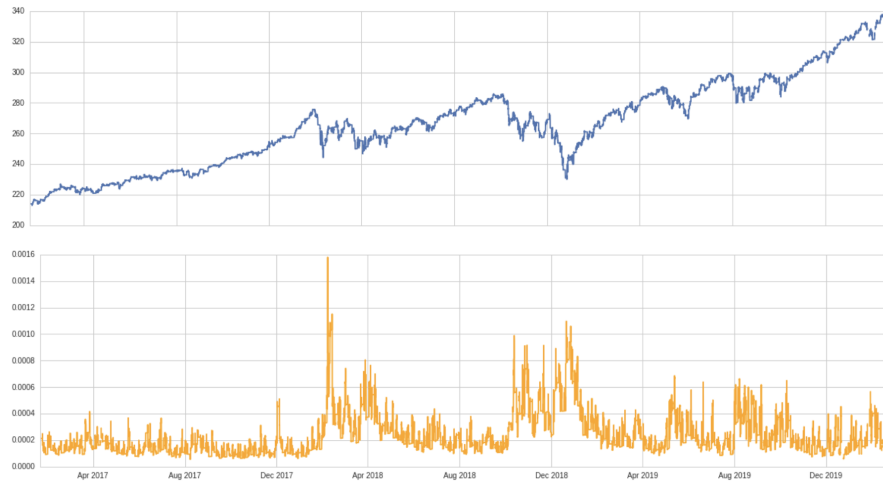


Figure 2: Graph of historical S&P stock price (blue) and realized volatility (orange) during Trump's term before the pandemic.

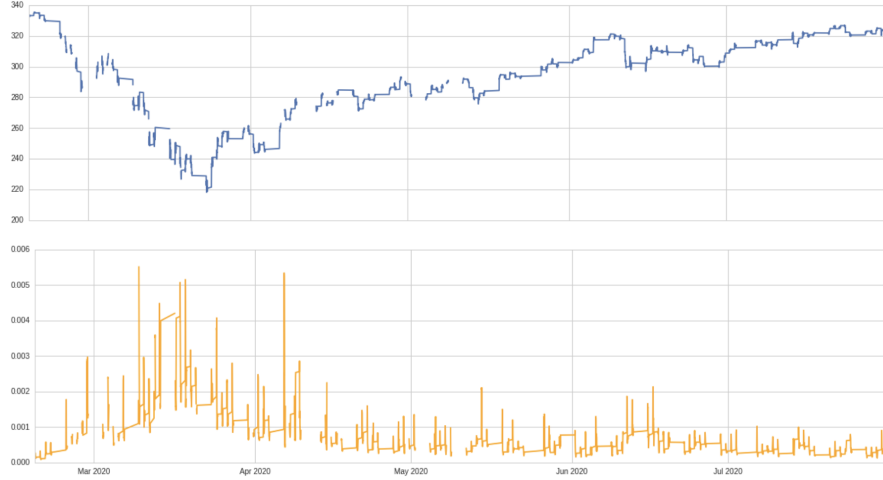


Figure 3: Graph of historical S&P stock price (blue) and realized volatility (orange) during Trump's term after the start of the pandemic.

We can compare the mean and standard deviation of the realized volatility during these two different periods to determine if there is a significant change in realized volatility. Before the virus, the mean realized volatility was 0.000258 with a standard deviation of 0.000281, while after the start of the virus the mean realized volatility was 0.000803 with a standard deviation of 0.001140. As expected, there was a significant increase in the realized volatility after the onset of the Coronavirus.

3.2 Comparing Realized Volatility Across Multiple Presidential Terms

The following figures show the result of running my volatility calculation on the presidential terms of Trump, Obama, and Bush.

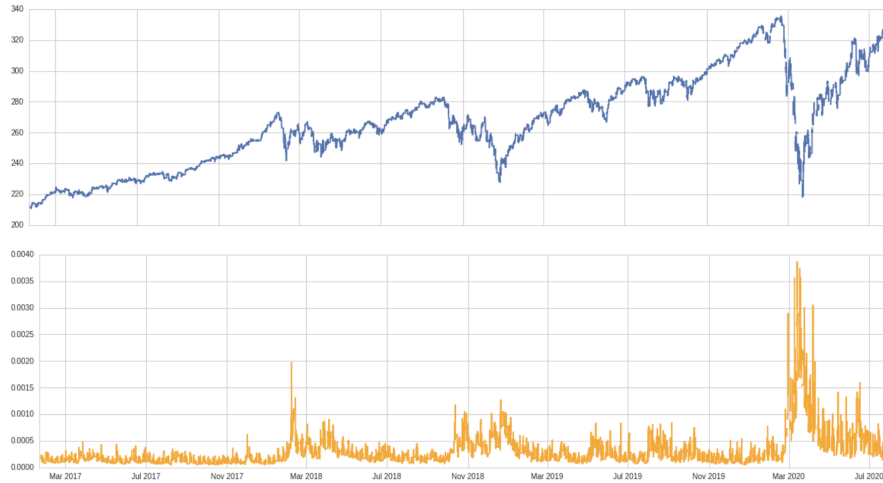


Figure 4: Graph of historical S&P stock price (blue) and realized volatility (orange) during Trump's term.

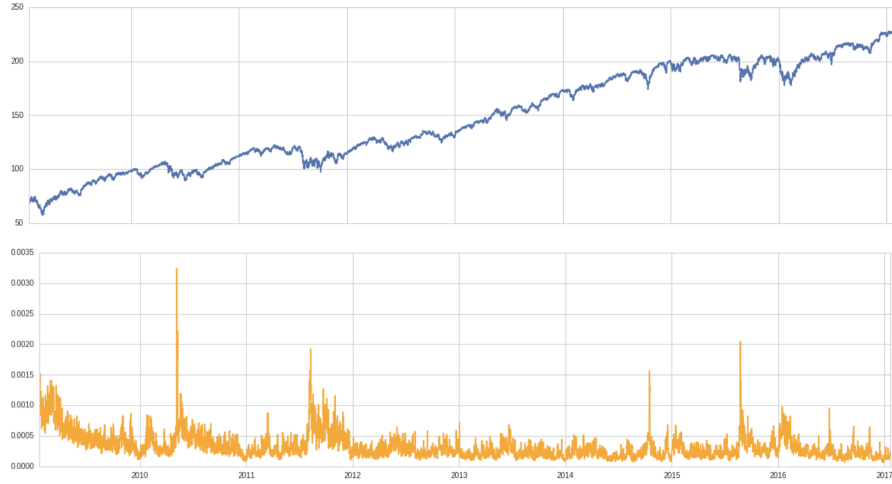


Figure 5: Graph of historical S&P stock price (blue) and realized volatility (orange) during Obama's term.

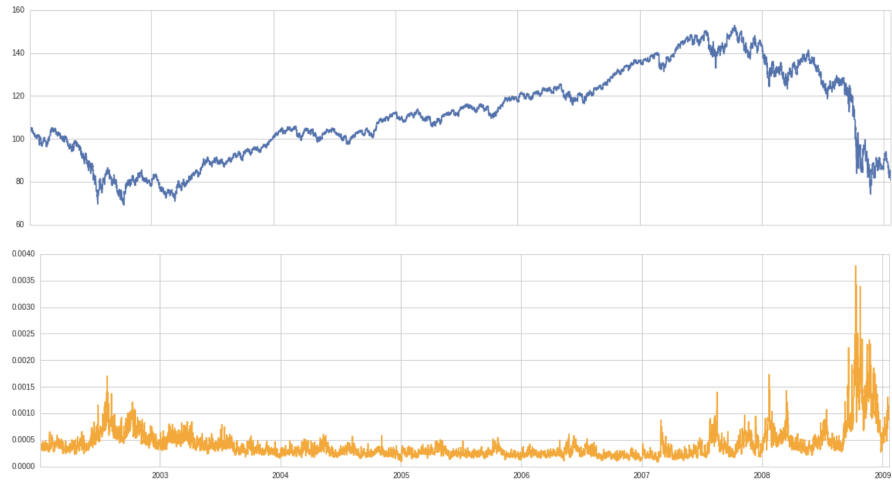


Figure 6: Graph of historical S&P stock price (blue) and realized volatility (orange) during Bush's term.

4 Future Directions

4.1 Implied Volatility

All of these results were in terms of realized volatility. I also plan on studying the effects Coronavirus had on implied volatility, which can be calculated off of option prices.

4.2 Volatility Regime Changes

I have shown that during the Coronavirus pandemic, the realized volatility of the S&P changed from one distribution to another. I plan on using different methods of regime change detection to determine if the volatility of the market is changing distribution, then attempting to trade off of this signal.