**Examining the S&P 500**

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The S&P 500 is an index consisting of the 500 largest U.S. stocks by market capitalization. It’s often used as a proxy for the overall strength of the economy. Looking at factors that are correlated with the S&P 500 can help individuals and firms predict where the economy is headed. The difficult aspect is deciphering causation vs. correlation because macroeconomic indicators tend to move together, but it’s hard to determine the leading indicators vs. the lagging. This paper is going to look at a few variables that are correlated with the S&P 500. The variables that are going to be reviewed are: Treasury rates, Unemployment rates, The Case-Schiller Index, and The Volatility Index (VIX).

**Comparing Treasury Yields and the S&P 500**

The Treasury Yield Curve is often referenced by financial analysts as a signal for how the economy is performing, as well as investor sentiment. A normal yield curve is upward sloping because investors require higher yields on treasuries with longer maturities due to the uncertainty about the future and increased risk. A steeper yield curve indicates investors expect economic growth and inflation in the future and a flatter yield curve reflects expectations that the economy will slow. At times the short-term rates exceed long term rates causing the yield curve to invert. This is usually, but not always, an indicator of a recession. Comparing the difference in treasury yields to the S&P 500 can show their influence in the stock market, as seen in Figure 1.

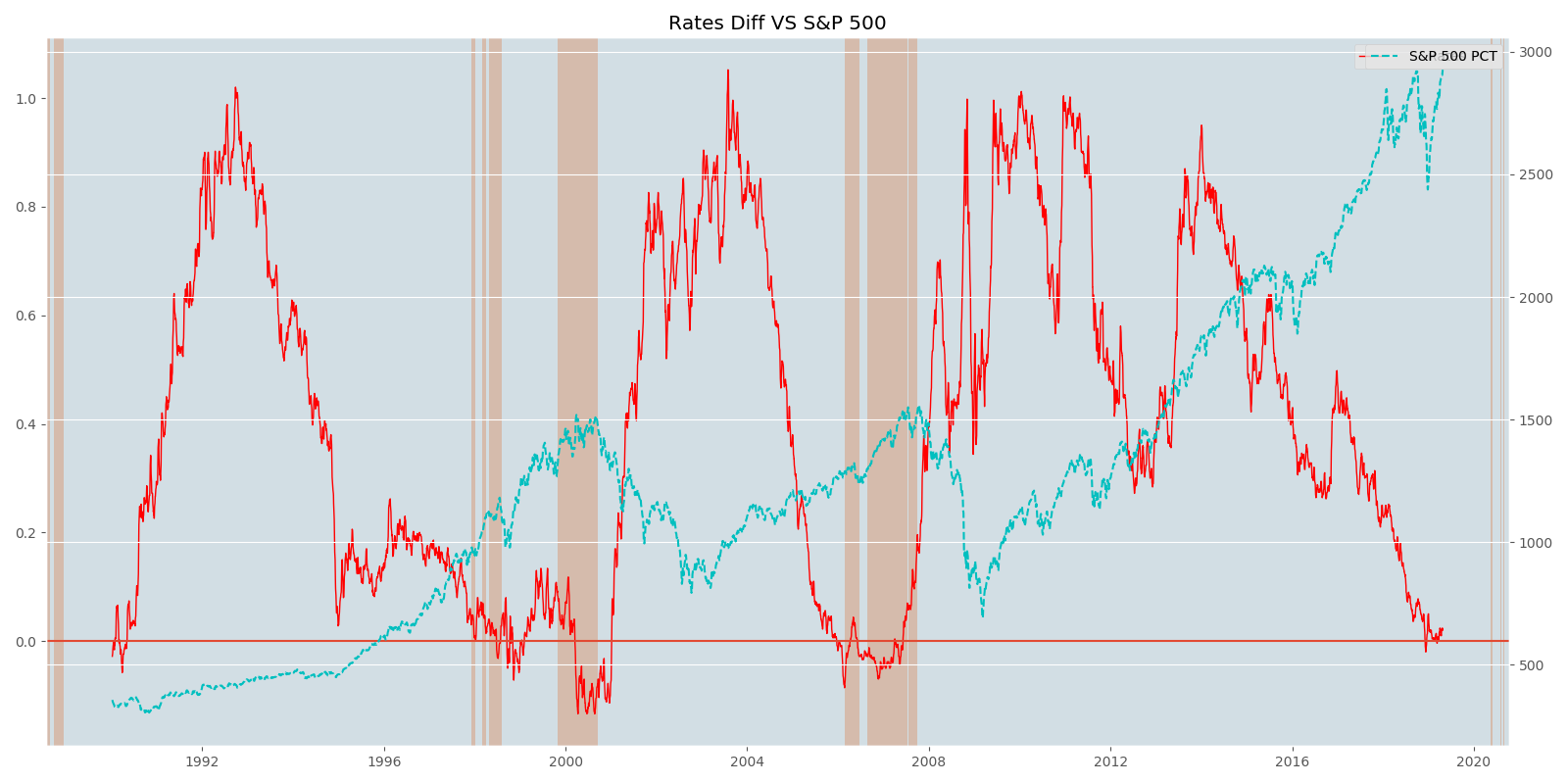


Figure 1

In figure 1, the red line represents the difference between the 5-year and 3-year treasury yields, the shaded sections show the time periods in which it was below zero. The blue line is the adjusted close of the S&P 500. This graph illustrates that the difference in treasury yields and the growth of the S&P 500 are inversely correlated. However, there have been instances where the difference in yields has become negative and a recession hasn’t followed, but the S&P 500 always dips. It’s important to note that to some extent this is a self-fulfilling prophecy; most investors are paying close attention to the treasury yield curve and when they see it invert, they pull money out of stocks and move it to safer assets such as treasuries. The treasury yield curve did briefly invert towards the end of 2018 but has reverted, but looking at how previous inversions occurred it seems likely that it will invert again within a year or two. This could indicate that a recession is looming, but it’s important to look at other economic factors as well.

**The Unemployment Rate and the S&P 500**

One of the primary effects of a recession is a dramatic increase in unemployment. The unemployment has been historically low over the past few years, but its hard to imagine it will stay there for much longer.[[1]](#footnote-1) One may be inclined to believe that the national unemployment rates shouldn’t affect the top 500 U.S. companies that dramatically but this isn’t the case as can be seen in figure 2. When a recession occurs, consumers start to spend less money hurting the profits of all firms regardless of size. As profits decline companies lay off workers leading to even less spending in the economy, causing a downward spiral. An interesting aspect of how unemployment affects firms is that during times of low unemployment, firms have to pay competitive wages to bring in quality workers, in other words the workers have the bargaining power. However, when unemployment rises the bargaining power shifts to the employers, and wages tend to stagnate. This concept is essentially the same as the relationship between inflation and unemployment first described by the economist William Phillips which is now referred to as the Phillips curve. While figure 2 does clearly show there is a relationship between the growth of the S&P 500 and the unemployment rate, the unemployment rate tends to lag behind the S&P 500; this is partly because it’s typically only reported monthly, as a higher frequency would be too volatile and inaccurate to be useful.

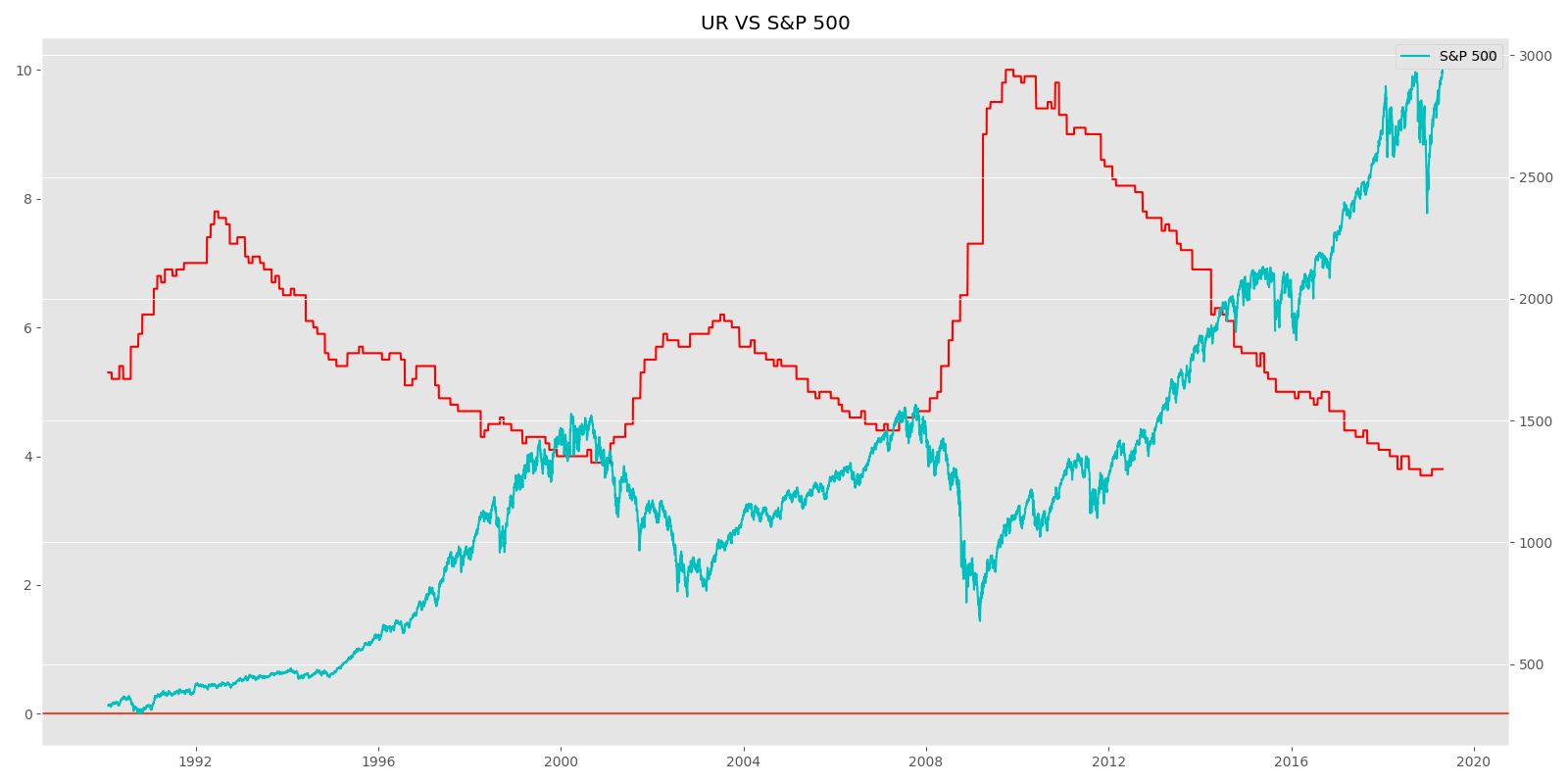


Figure 2

**The Case-Shiller Index and the S&P 500**

The Case-Shiller Index tracks repeat sales of single-family homes over time and is used as a proxy for the housing market. Prior to the bursting of the housing bubble during the 2008 recession, the housing market was often referred to as the “bedrock” of the American economy. While it may seem odd to look for a correlation between home prices and the S&P 500 it can provide useful information. Figure 3 shows that the Case-Shiller Index and S&P 500 follow the same general trend, but aren’t nearly as correlated as the previous two variables. There are a few interesting bits of information from this graph. First, it’s clear that the 2008 recession negatively impacted the housing market. What’s even more interesting though is that when the tech bubble burst in 2000, the Case-Shiller index was unaffected. In fact, this was the start of the steepest rise the index had ever seen. Once the 2008 recession ended the index recovered rather quickly and now exceeds the 2007 peak, but does seem to be slowing down.

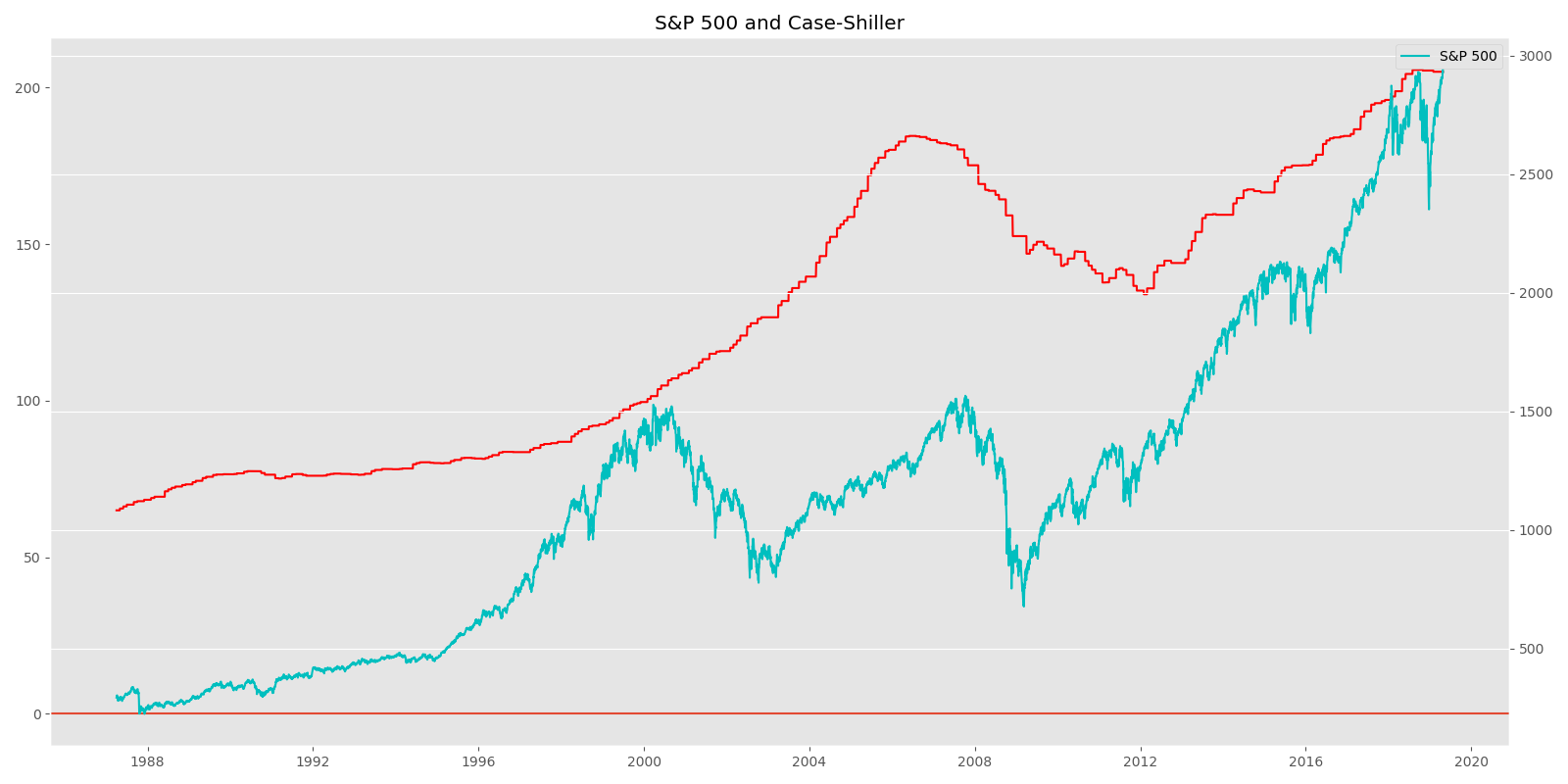


Figure 3

While this information is incredibly valuable when analyzing markets and the U.S. economy as a whole, it doesn’t work as a predictive indicator. This is because housing prices, like unemployment, tend to lag behind the S&P 500. Again, this is partly because of the frequency in which the data is gathered and released. It could also be explained by the way consumers adjust their spending during economic downturns. Mortgages tend to be the last thing people will default on, causing the reduction in home prices to occur significantly after the reduction in other goods.

**The VIX and S&P 500**

Another indicator of economic performance is the volatility index or VIX for short. When markets are strong, they tend to increase at a steady pace and are less volatile. When negative shocks hit the market investors panic and volatility increases significantly. It’s important to note that the VIX is the 30-day volatility expectation based on S&P 500 price variation. Similar to the treasury yield curve, the VIX is a representation of investor’s sentiment about the market. When markets are strong the VIX is relatively low, but when investors become uncertain about the future, volatility increases. Figure 4 shows the VIX plotted along the S&P 500.

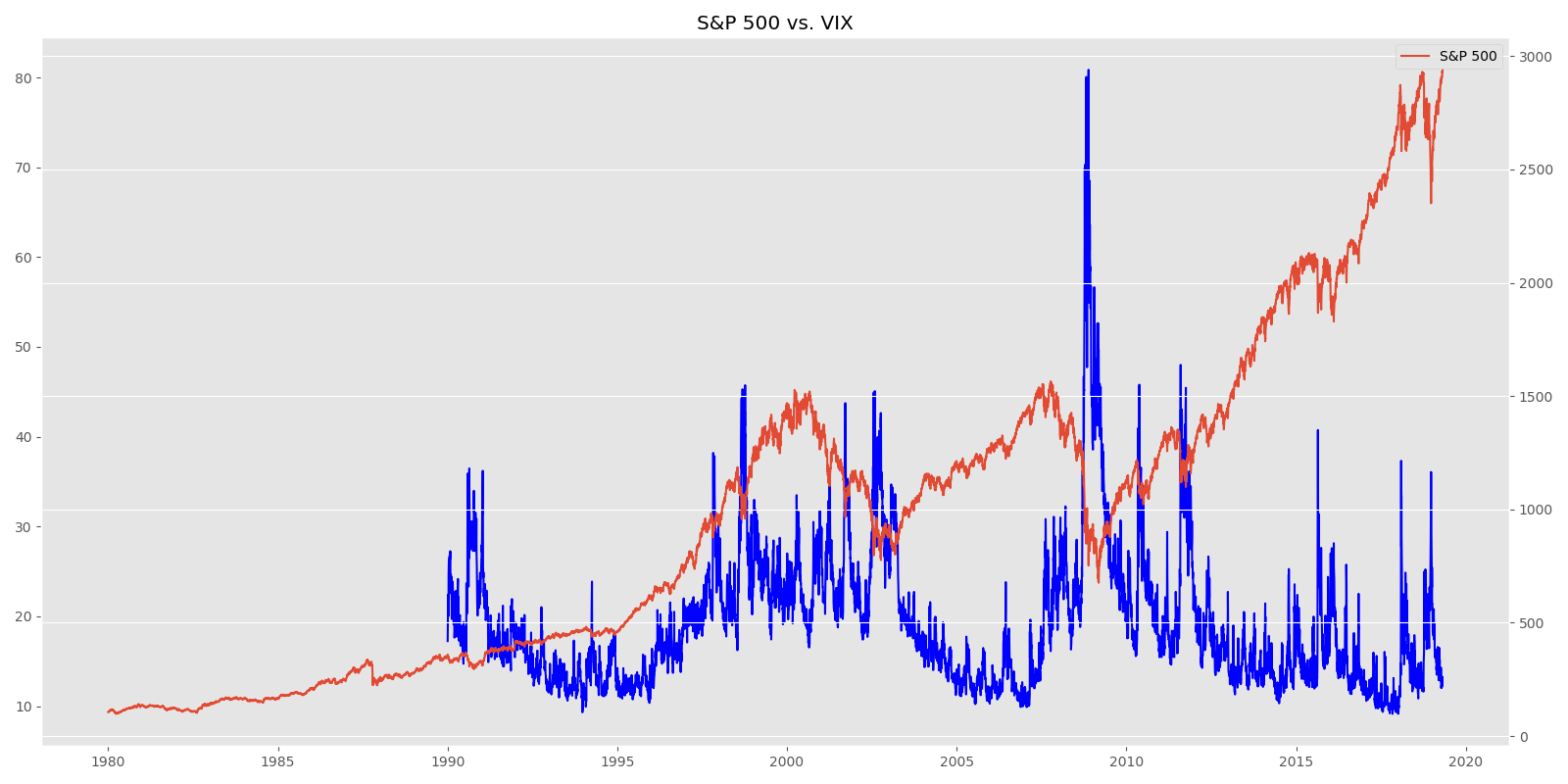


Figure 4

Figure 4 illustrates that the VIX is negatively correlated with the S&P 500, but there do seem to be some false positives. For example, just before 2000 there were significant spikes in the VIX and the S&P 500 barely dipped. However, during the 2 major market crashes over this time period it is clear that the VIX increased dramatically. It’s hard to tell whether the VIX leads the S&P 500 or is just in unison.

**Regression Analysis**

Table 1: Regression Results

|  |  |
| --- | --- |
| Independent Variable | Coefficient  (Std. Error) |
| Unemployment Rate | -97.94  (3.34) |
| VIX | -4.95  (.472) |
| Case Shiller Index | 11.87  (.089) |
| Difference Between 5yr. and 3yr. Treasury Yields | 39.29  (16.20) |
| Adjusted R-Squared | .752 |

Table one shows regression results from an ols regression defined as:

S&P 500 Price = Unemployment Rate, VIX, Case Shiller Index, Difference between 5yr. and 3yr. Treasury Yields)

All of the independent variables were statistically significant at the 99% confidence level. The signs on the coefficients are what was expected based on the graphs as well as prior knowledge of their correlation. The primary issue with this regression is that there is likely a high degree of multicollinearity between the independent variables. To address this, the following regressions omit different variables as well as test each individual independent variable by itself.

Table 2: Correlation Matrix

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | S&P 500 Adj. Close | Unemployment Rate | VIX | Case Shiller Index | Difference Between 5yr. and 3yr. Treasury Yields |
| S&P 500 Adj. Close | 1 |  |  |  |  |
| Unemployment Rate | -.347 | 1 |  |  |  |
| VIX | -.181 | .125 | 1 |  |  |
| Case Shiller Index | .832 | -.135 | -.114 | 1 |  |
| Difference Between 5yr. and 3yr. Treasury Yields | -.173 | .711 | .096 | -.015 | 1 |

Table two shows which of the independent variables are most correlated with the others, and there doesn’t seem to be as much multicollinearity as expected. The only independent variables that may cause a problem are the Difference Between 5yr. and 3yr. Treasury Yields and the Unemployment Rate.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Independent Variable | Coefficient  (Std. Error) | Coefficient  (Std. Error) | Coefficient  (Std. Error) | Coeff.  (Std. Err.) | Coeff.  (Std. Err.) |  |
| Unemployment Rate | -92.17  (2.35) |  | -137.97  (4.35) |  |  |  |
| VIX | -4.92  (.472) | -5.81  (.498) |  | -14.52  (.920) |  |  |
| Case Shiller Index | 11.90  (.088) | 12.31  (.093) |  |  | 12.47  (.097) |  |
| Difference Between 5yr. and 3yr. Treasury Yields |  | -299.22  (12.02) |  |  |  | -336.69  (22.39) |
| Adjusted R-Squared | .752 | .723 | .120 | .033 | .692 | .030 |

After running regressions that omit the highly correlated independent variables the results are relatively the same as before. The regressions with only one independent variable gave the expected results; the coefficient increased a significant amount but the adjusted R-squared is extremely low. It’s interesting to see that the R-squared on the regression that omits the treasury yields is the same as the first regression that had no omissions. Overall the results coincide with prior expectations. The unemployment rate, VIX, and difference in treasury yields are all negatively correlated with the S&P 500. The Case Shiller Index is positively correlated with the S&P 500, and all coefficients were statistically significant at the 99% confidence level across all regressions.

**Future Research**

The purpose of this paper was to examine the correlation between various variables and the S&P 500. Further research could look more into which variables can consistently be used to predict future values of the S&P 500. Another interesting thing to look at is which companies have been dropped and added to the S&P 500 over the past decade to understand which sectors are thriving. For example, a couple of video games publishers have recently been added the S&P 500 which is likely caused the growth of Esports in recent years. I personally will likely be posting future work looking at these variables.

1. You can look at my work examining and forecasting the unemployment rate at github.com/conweezy [↑](#footnote-ref-1)