How COVID-19 Has Changed the Volatility of Different GICS Sectors Within the S&P500 From the Same Time in 2019, A Preliminary View.

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Author contributions.

A.H. proposed the research question, designed the study, wrangled the data, analysed the results, and drafted the paper.

Abstract.

This paper analyses stock volatility of every CIGS sub-industry during the COVID-19 pandemic and compare it to the same time last year. The method used was to compare the average price movement for each industry to the rest of the market, using ordinary linear regression to calculate the Beta Coefficient of an individual industry with regards to all other S&P500 stocks, not in that industry. This paper has found that all stocks with a previous negative correlation to the market now have become positive, including the 'safe haven' from market volatility, gold. Stocks that once had a near-perfect correlation to the market have also strayed from their norms becoming more volatile, such as real estate, and restaurants. A large number of industries moved with the market similar to last year, while others have become less correlated. Overall there was a large percentage of industries that either increased or decreased their correlation and volatility to the market. This paper provides valuable insights to anyone making financial decisions based on risk and gives a clear view of how different industries react to COVID-19 as well the events associated with the pandemic.

Keywords.

python, NumPy, pandas, COVID-19, finance, SPY, regression, analysis, markets, Nasdaq

Introduction.

The COVID-19 pandemic has seen a sharp increase in the volatility of the stock market (Z. Ye, I. Florescu, 2020) with the S&P 500 seeing some of the sharpest price swings since the 1987 stock market crash, also known as Black Monday (NASDAQ, 2020). Every day new COVID-19 developments are released, causing mass uncertainty in the market.
The beta coefficient β of a stock is used to measure how volatile it is against the market during a particular time-series. β x 100 shows the overall percentage of the volatility of the stock with regards to the overall market. If β>1 then the stock is more volatile than the market, and vice versa. If β<0, it is negatively correlated to the market (Corporate Finance Institute, 2015). GICS is arguably the most widely used standard, with the advantage of being consistent across different applications for effectively grouping stocks with similar operating characteristics (Hrazdil, Trottier, & Zhang, 2013). The first lockdown of an S&P500 headquarters was the 19th of March (Calfas, Stancati, & Yap, 2020).
This paper provides a detailed analysis of the Beta Coefficient for each sub-industry within the GICS from this date up to May 25th, as the research was preliminarily conducted on this date . This will determine how industries' volatility compares to the rest of the market during the unprecedented lockdown, social distancing, and states of emergency. This research hopes to answer the question "How has the volatility between different GICS sectors within the S&P500 changed during the COVID-19 pandemic, compared to the same time in 2019?"[1]

How will this help the public?

Economic policy can be directed to mitigate volatility and ensure better returns from more vulnerable industries. Policymakers will be more informed when allocating resources such as social and corporate welfare and run a more in-depth cost-benefit analysis to determine where tax-payers' money should go (Tarhan, 1993).
Furthermore, the average retirement 401(k) balance was $106,000 in Q2 2019, with 196,000 Americans holding over $1m in their retirement fund (Fidelity Investments, 2019). Fund managers could use this research to better allocate people's money that suits their clients' desired risk regarding their portfolio's performance. For example, those living off of pensions or retirement funds may want their money to be invested in something that is less prone to COVID-19 related events.

The Standard & Poor 500 index was studied, which covers about 80% of the available market capitalisation (S&P 500, 2020) within the NASDAQ. As the inclusion of stocks in the S&P500 are dynamic, historical data is used for comparison for each time period. Note that this is not an Australian market, so may not be reflective of our conditions.

The null hypothesis H_0, is that the standard deviation of change in volatility is less than 0.05. Meaning that there was no change in volatility between 2019 and 2020.

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[1] The original question proposed was "*How do different US industries differ in stock price movement for major disease-related policy and statistical announcements during the COVID-19 pandemic?"*

The remaining sections of this paper cover the method, results, a discussion of the results, and a conclusion.

Method.

Categorising stocks into separate industries.

A data table (List of S&P 500 companies, 2020) (S&P 500, 2020) was scraped to create a data frame using the Pandas python library for each stock included in the S&P500. The data was filtered to distinguish stocks based on their GICS sub-industry classification. In total 126 sub-industries categorise 504 stocks.

Downloading the data.

For each stock's unique ticker, Yahoo Finance API was used to download the price history for the specified date range. The percentage change between each Adjusted Close was calculated for each ticker in that industry (Fig.1).

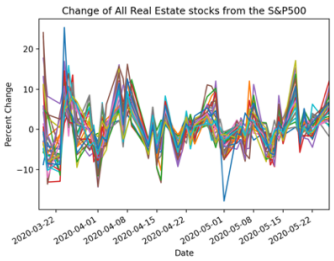

Fig. 1 shows the % change for each. Real Estate Stock.

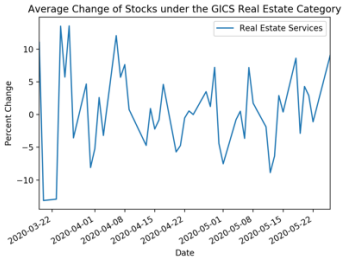

Fig. 2 shows the mean of all Real Estate stock's change.

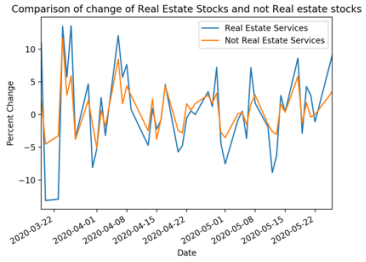

Fig.3 shows the mean percent change for S&P500 excluding Real Estate.

Separating the population.

Once the percentage of change between the Adjusted Close price for each stock was calculated (we will refer to this as *P*) the sum of each row in *P* was divided by the size of *P* (e.g. 'Real Estate' has 31 individual stocks) in that category to determine the mean of percentage change between Adjusted Close (Fig.2).

The same was done for every stock not within the category, this will be referred to as *P'* and will be used as the benchmark to analyse against, as seen in Fig.3. The reason for comparing an industry to all the other stocks excluding the current industry was because some industries, such as real estate, take a bigger proportion of the S&P meaning they, as previously mentioned, would contribute a greater weight creating bias.

Regression Analysis.

The beta coefficient was calculated through an ordinary least squares regression model. The standard deviation was calculated on each Δβ , as to determine how much the industries deviate from the mean. (Grabowski & Pratt, 2014) This was repeated once for each year. The above figures illustrate the process for determining a single industries' return for comparison to an entire industry, within a single year.

The mean of Δβ is always expected to be 0, as the average beta coefficient will always be 1, as β=1 indicates an exact correlation to overall market performance. Thus, any positive Δβ for one stock means a negative Δβ for another.

$$\text{Beta Coefficient } (\beta) = \frac{Covariance(R_P, R_{P\prime})}{Variance\ (R_{P\prime})}$$

Results.

$\mathbf{R_P}$ = Return of an industry $\mathbf{R_{P'}}$ = Return of everything not within the industry.

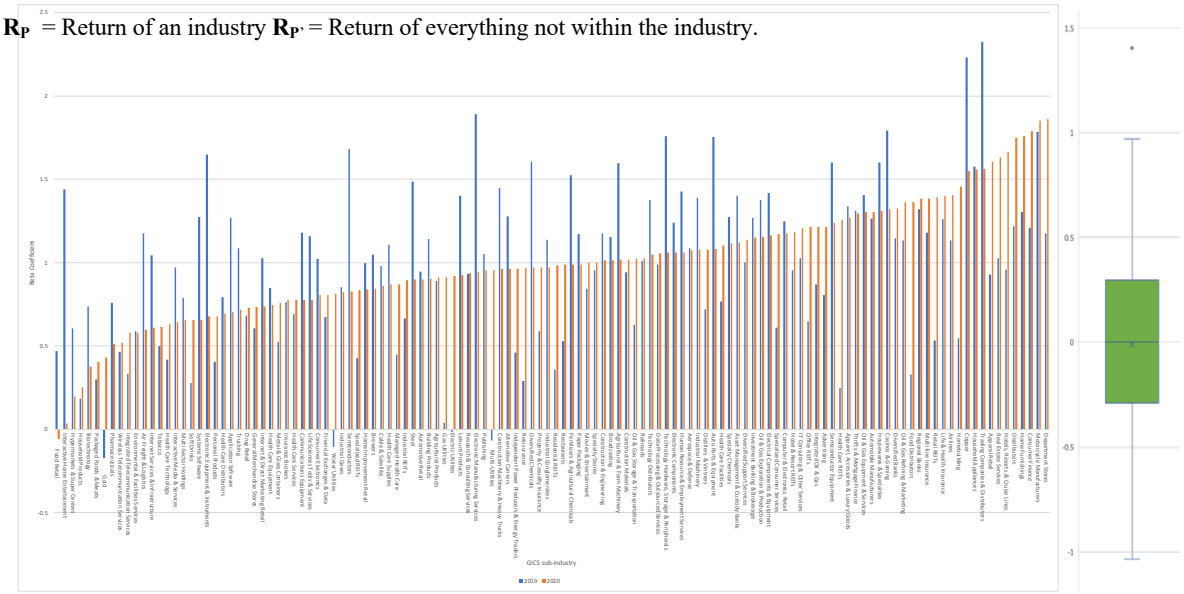

Fig.4 shows the beta coefficient for all 126 sub-industries within the S&P500. Sorted by 2020 Beta Coefficient. 2020

Date Range for Fig.4: 19/03/2020 through 26/05/2020

Pricing time for Fig.4: Adjusted Close

Fig.5 shows the range, inter-quartile-range, the median, and outlier for Δβ from the 126 different sub-industries

Some industries in Fig.4 showed a large $\Delta\beta$, while others stayed similar. With 28.6% of industries having $|\Delta\beta| > .5$ multi-utilities, gold, and water utilities volatility turned from going against the market with $\beta < 0$ indicating a negative relationship, to going with market behaviour as indicated by $\beta > 0$. Food Retail was the only industry with $\beta < 0$, compared to $\beta = 0.47$ in the previous year. interactive home entertainment was the only outlier, with $\Delta\beta = 1.4$. $\sigma(\Delta\beta) = 0.4609$, and the range of $\Delta\beta$ was 2, as seen in Fig.5. The null hypothesis can be rejected.

Discussion.

Industries with higher than market volatility.

High volatility on prices for industries such as Department Stores and Home Furnishings when compared to 2019 could indicate that these are the most affected by uncertainty, communication regarding policy could be a factor leading to volatile speculation (Hayo, Kutan, & Neuenkirch, 2012). High volatility could also indicate that the stocks are more so affected during announcements such as lockdown, stimulus, social distancing laws, and supply chain strain. Supply chains are expected to be impacted well beyond the pandemic (Ivanov, 2020) which could also explain why manufacturers have seen increased volatility.

What could be causing industries to have no association with the overall market?

Air freight and logistics' stocks aren't moving with the market as much as in 2019. This could be attributed to cheaper fuel (Albulescu, 2020) and a larger supply of planes due to reduced air travel being a positive for the industry. Whilst reduced consumerism (Baker, Farrokhnia, Pagel, Yannelis. 2020) could be seen as negative. Having $\beta = 0$ could be an indication that the market sees COVID-19 market events as a balance of positive and negative towards the industry. Another noticeable low volatility industry is interactive home entertainment, this could be attributed to stay-at-home boredom increasing the necessity of at-home entertainment services (Taylor, 2020), but the lack of a negative Beta could indicate that as consumers are earning less money due to record unemployment (Coibion, Gorodnichenko, & Weber, 2020), and with lockdowns already being reduced (Garnett, 2020) households may soon view at-home entertainment as a luxury expense. Studies in the future could use this data to link market caution with changed consumer perception of good and services. Low betas could indicate industry initially moving with/against the market, then as observation of how different industries adapt to market events, the correlation to the market changes.

What goes against the market?

Food retail is the only stock that has turned to be against the market. The initial surge in market price during the 'panic buying' happened at the same time the market was crashing; however further research would need to be done to determine why this is the case. Although the correlation is negative it is not strong (-0.056).

Gold has gone against its reputation.

The gold industry has been recognised as a safe haven in extreme stock market conditions in the past (Baur & Lucey, 2010), however, has seen an increased risk having 43% of the market's volatility, with a positive correlation when in 2019 it was 17.1% with a negative correlation. More research would need to be done to try and determine why gold industries have begun to move with the market during COVID-19.

Could there be a link between essential businesses and volatility?

Restaurants' volatility went from 102% to 163% of the market. This poses the question of how could lockdowns of specific industries like restaurants impact their market performance? Once again more research could be done.

How could this study be extended or improved?

Using the above method to compare industries during different time periods of the pandemic, comparing volatility for specific events rather than from the 19th of March to the 26th of May could give insight to how industries react to particular major events. For the scope of this study, however, the 9 week period gave enough data to compare the majority of the global event against the previous year. Comparing the data against past years and determining if the change in volatility for each industry is significant, or if it possibly part of some kind of pattern. The same method above could be used for many stocks across many markets. For further insight, every stock on the NASDAQ could be added by using every ticker symbol in the NASDAQ and subsequently categorising them, providing a larger dataset overall whilst including industries that are not in the S&P500 which may provide important information.

Conclusion.

Every day COVID-19 creates new speculation on how the market will perform. The change in stock volatility for unique sub-categories within the S&P500 indicates that the pandemic has a larger effect on some industries than others. Food Retail was the only industry with a negative relationship with the market.. The volatilities have changed, but only for a portion of industries. Some industries maintained similar volatility to 2019. I would recommend that future research be done that gives an explanation to the changes in market behaviour and how to mitigate any issues that it may be causing. These findings offer an insight that could be significant in deciding economic policy and could also help future researchers to evaluate the effects that COVID-19 has had on specific industries.

Bibliography.

Albulescu, C. (2020). *Coronavirus and Oil Price Crash.* University of Timisoara. Retrieved from https://www.researchgate.net/publication/339946321_Coronavirus_and_oil_price_crash_A_note

Baur, D. G., & Lucey, B. M. (2010). Is Gold a Hedge or a Safe Haven? An Analysis of Stocks, Bonds and Gold. *Financial Review*, 217-229.

Calfas, J., Stancati, M., & Yap, C.-W. (2020, March 19). *California Orders Lockdown for State's 40 Million Residents*. Retrieved from Wall Street Journal: https://www.wsj.com/articles/china-reports-no-new-domestic-coronavirus-infections-for-the-first-time-since-outbreak-started-11584611233 accessed on 15/5/2020.

Coibion, O., Gorodnichenko, Y., & Weber, M. (2020). *Labor Markets During the COVID-19 Crisis: A Preliminary View.* National Bureau of Economic Research. Retrieved at https://ideas.repec.org/p/ces/ceswps/_8238.html

Corporate Finance Institute. (2015). *What is beta guide*. Retrieved from Corperate Finance Institute: https://corporatefinanceinstitute.com/resources/knowledge/valuation/what-is-beta-guide/ on 12/5/2020

Economic Times. (2020, April 25). *US states begin easing lockdowns as virus weakens in Asia Read more at: https://economictimes.indiatimes.com/news/international/world-news/us-states-begin-easing-lockdowns-as-virus-weakens-in-asia/articleshow/75370662.cms?utm_source=contentofinterest&ut.* Retrieved from The Economic Times: https://economictimes.indiatimes.com/news/international/world-news/us-states-begin-easing-lockdowns-as-virus-weakens-in-asia/articleshow/75370662.cms accessed on 25/5/2020

Fidelity Investments. (2019). *Fidelity® 2019 Retirement Analysis: A Record Number Of People Boost Their Savings Rate In Q2 As Average Account Balances Continue To Increase.* Smithfield: Fidelity Investments.

Garnett. (2020, May 27). *Map of when US states are ending lockdown*. Retrieved from USA Today: https://www.usatoday.com/storytelling/coronavirus-reopening-america-map/ on 18/5/2020

Grabowski, R. J., & Pratt, S. P. (2014, March). *Examples of Computing OLS Beta, Sum Beta, and Full information Beta Estimates.* Retrieved from Wiley Online Library: https://onlinelibrary.wiley.com/doi/10.1002/9781118846780.ch11a

Hayo, B., Kutan, A. M., & Neuenkirch, M. (2012). Communication matters: US monetary policy and commodity price volatility. *Economic Letters*.

Hrazdil, K., Trottier, K., & Zhang, R. (2013). A comparison of industry classification schemes: A large sample study. *Economic Letters*, 77-80.

List of S&P 500 companies. (2020, 5 25). Retrieved from Wikipedia: https://en.wikipedia.org/wiki/List_of_S%26P_500_companies accessed on 25/5/020 and 25/5/2019 (archive).

NASDAQ (2020) *https://www.nasdaq.com*

S&P 500. (2020, 5). Retrieved from S&P Dow Jones Indeces: https://us.spindices.com/indices/equity/sp-500

Scott R. Baker, R.A. Farrokhnia, Steffen Meyer, Michaela Pagel, Constantine Yannelis (2020). How Does Household Spending Respond to An Epidemic? Consumption During The 2020 Covid-19 Pandemic. National Bureau of Economic Research. Retrieved from: https://www.nber.org/papers/w26949.pdf accessed on 24/4/2020

Sizzlers and Fizzlers. (2020, April). Retrieved from SPI Indeces: https://us.spindices.com/indexology/djia-and-sp-500/sizzlers-and-fizzlers accessed on 24/4/2020

Tarhan, V. (1993). Policy and volatility of asset returns. *Journal of Economics and Business*, 269-283.

Taylor, J. (2020, March 26). *Netflix is reducing streaming quality amid coronavirus. How will it affect viewing in Australia?* Retrieved from The Guardian: https://www.theguardian.com/media/2020/mar/26/netflix-is-reducing-streaming-quality-amid-coronavirus-how-will-it-affect-viewing-in-australia accessed on 25/5/2020

Ye, Ziwen and Florescu, Ionut, (2020) COVID-19 and the Equity Market . A March 2020 Tale Available at http://dx.doi.org/10.2139/ssrn.3566281