Using the Beat coefficient to compare the volatility of different industries market return during COVID-19 compared to the past

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Author contributions. A.H. proposed the research question, designed the study, conducted the survey, wrangled the data, analysed the results, drafted and edited the paper.

Abstract. I analyse stock volatility of each individual CIGS sub-industry during the COVID-19 pandemic and compare it to the same time last year.

Introduction.

The COVID-19 pandemic has seen a sharp increase in the volatility of the stock market (Z. We, I. Florescu, 2020). The S&P 500 has seen some of the sharpest increases as well as declines since the 1987 stock market crash, also known as Black Monday (NASDAQ, 2020). Every day new COVID-19 developments are released, causing mass uncertainty.

With this paper I provide a detailed analysis of the Beta Coefficient for each individual sub-industry within the Global Industry Classification Standard (GICS). This will determine how industries' volatility compares to the rest of the market during unprecedented lockdown, social distancing, and states of emergency.

This will allow for investors, policy makers, financial analysts, as well as other economic researchers to better understand how each industry behaves to allow for a more informed decision making process in the future.

How will this help the public? Policy can be directed to mitigate volatility and ensure better returns from more vulnerable industries. Policy-makers will be more informed when allocating resources such as social and corporate welfare and run 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

The Standard & Poor 500 index was studied, which covers about 80% of the available market capitalisation (S&P 500, 2020). As the inclusion of stocks in the S&P500 are dynamic, historical data is used for comparison.

The null hypothesis is that the standard deviation of change in volatility is equal to 0. Meaning that there was no change in volatility between 2019 and 2020.

[1] The original research question was "*How has the volatility between different GICS sectors within the S&P500 changed during the COVID-19 pandemic, compared to the same time last year?*"

Method.

Categorising stocks into particular industries. GICS is arguably the most widely used standard, with an advantage of being consistent across different applications for effectively grouping stocks with similar operating characteristics (Hrazdil, Trottier, & Zhang, 2013).

I scraped a data table (List of S&P 500 companies, 2020)(S&P 500, 2020) to create a data-frame using the Pandas python library for each stock included in the S&P500. I then filtered the data to distinguish stocks based on their GICS sub-industry classification. In total, there are 126 sub-industries grouping 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, then the mean of these percentages was taken. As seen in Fig.1 and Fig.2.
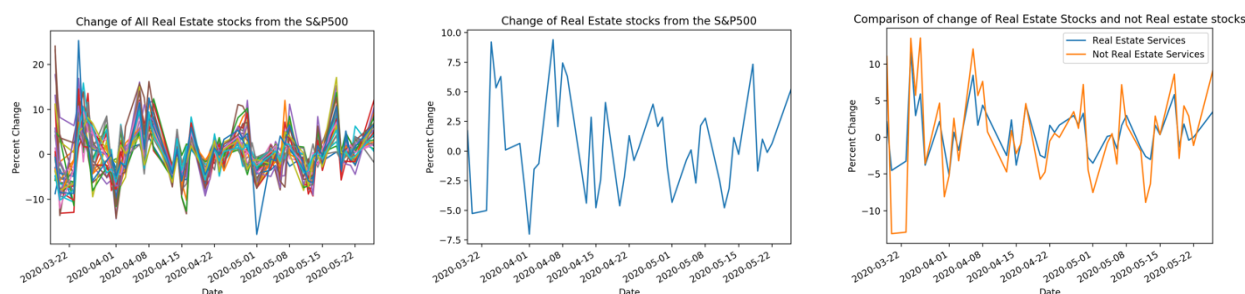

Fig. 1 shows the % change for each Real Estate Stock. **Fig. 2** shows the mean of all Real Estate stock's change. **Fig.3** shows the mean percent change for S&P500 excluding Real Estate.

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

The same was done for every stock that was not a part of 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 β of 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 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<1, it is negatively correlated (Corporate Finance Institute, 2015). The beta coefficient was calculated through an ordinary least squares regression model. The standard deviation was calculated on each Δβ , as to determine how m

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

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

Results.

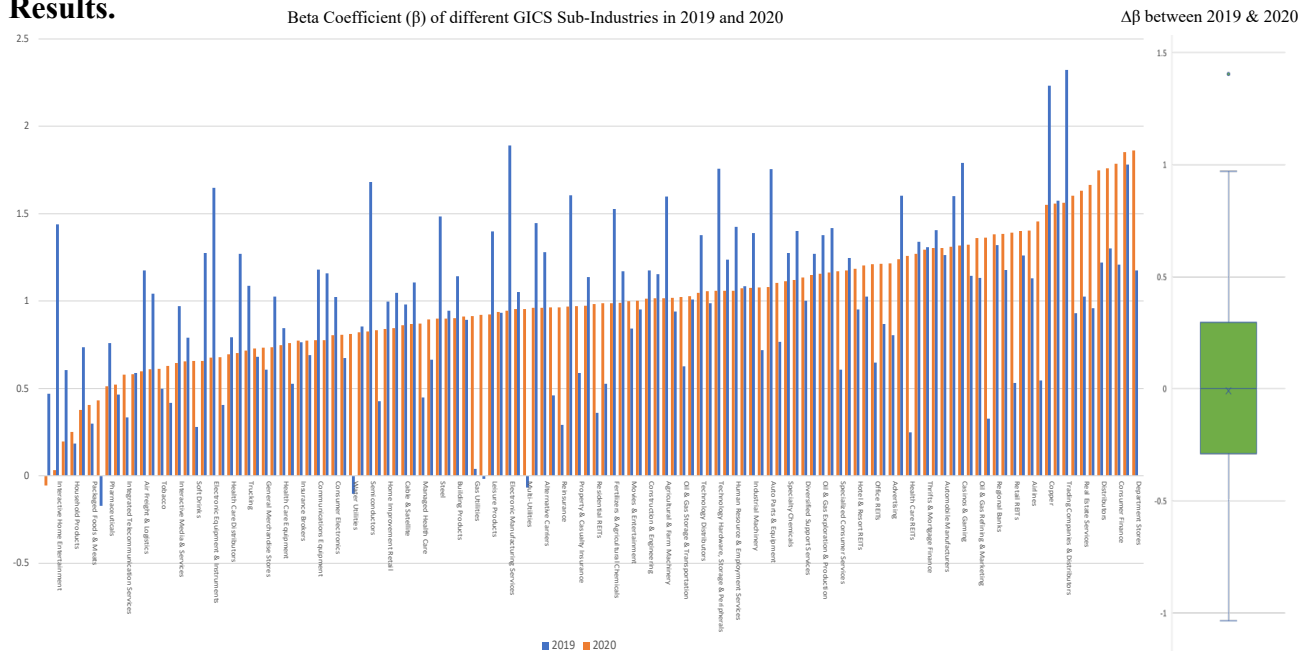Beta Coefficient (β) of different GICS Sub-Industries in 2019 and 2020 — Δβ between 2019 & 2020

Fig.4 shows the beta coefficient for all 126 sub industries within the S&P500. Sorted by 2020 Beta Coefficient. Blue lines indicate the volatility for the same period in 2019.
Date Range for Fig.3: 19/03/2020 through 26/05/2020
Pricing time for Fig.3: Adjusted Close

Some industries in Fig.4 showed large Δβ, while others stayed similar. With 28.6% of industry having |Δ β |>.5 Multi-Utilities, Gold, and Water Utilities volatility turned from going against the market with β < 0 indicating a negative relationship, to going with market behaviour as indicated by β > 0 , Food Retail had the inverse behaviour. Interactive Home Entertainment was the only outlier, with Δβ being ~1.4.σ(Δ β) = 0.4609. Disproving the null hypothesis.

Discussion.

Analysis of specific industries. 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. Stocks that were previously volatile have seen less movement with the market;

Air Freight and logistics isn't moving with the market as much as it used to. This could be attributed to cheaper fuel (Albulescu, 2020) and larger supply of planes due to reduced air travel meaning the industry is less affected.

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 households may soon view at home entertainment as a luxury expense (Garnett, 2020). Studies in the future could use this data to link market caution with changed consumer perception of good and services.

Low betas might also be associated a long road to recovery regardless of current market events (e.g. Restaurants).
High volatility industries such as Department Stores and Home Furnishings indicates 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. The chain reaction of supplies being unavailable is expected to last well beyond the pandemic (Ivanov, 2020), and this could explain why manufacturers have seen increased volatility.

What goes against the market?   Food Retail is the only stock that has gone against the market. The initial surge in market price during the 'panic buying' happened at the same time the market was crashing

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 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. Something insightful could be to use every stock on the NASDAQ by crawling a list of ticker symbols and subsequently scrubbing webpages for what industry relates to each stock. Providing a larger dataset.

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 to the market.
Almost one third of the industries gained or lost .5 off of their beta coefficient from the same trading period last year. This disproves the null hypothesis, but only for a portion of industries. Some industries maintained a similar volatility to the year prior.

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