Impact of COVID-19 and SARS on the American Airline Industry

Introduction

Throughout history, there have been many outbreaks; the most recent ones include SARS and COVID-19. Severe acute respiratory syndrome (SARS) is a viral respiratory illness caused by a coronavirus called SARS-CoV. More recently, the Coronavirus (COVID-19) outbreak was officially declared as a global pandemic on March 11, 2020. It is believed that it started in December of 2019 when dozens of cases with symptoms similar to viral pneumonia appeared in Wuhan, China. This virus has spread to more than 180 countries ever since, and as of May 2021, it has already affected 154 million, with 3.22 million deaths. COVID-19 spreads between people mainly through cough droplets when in close contact (less than 6 feet) with one another.

Both of these outbreaks have a lot in common, and similar measures were taken to stop the spread. Countries adopted partial or complete lockdowns depending on the severity of the illnesses. Other policies to halt the spread included work from home, closures of the academic institutions, limited capacity in restaurants/bars and travel restrictions. Consequently, economic sectors directly related to international travel such as tourism, goods transportation and retail were adversely affected. The whole stock market was greatly affected by this. This paper is interested in investigating the effects of the SARS and COVID-19 outbreaks on the Volatility of Airline Industry stocks. This was done through different methods of calculating the volatility which is essentially representing the change in market or index prices. Noticing the similarities between both pandemics, I think that **the effect of both the SARS outbreak and Coronavirus pandemic affected the airline industry stocks similarly.**

Data

The data for this project is collected from kaggle: https://www.kaggle.com/jacksoncrow/stock-market-dataset and the quantmod package in R which extracts data from https://robinhood.com/us/en/.

The data collected has the timeline as a row key and company stock as a column key. The S&P 500 index (The Standard and Poor's 500,or simply the S&P 500,[4] is a free-float, weighted measurement stock market index of 500 of the largest companies listed on stock exchanges in the United States. It is one of the most commonly followed equity indices–wikipedia) is the a column key and the time as a row key. The data was originally from the US stock market and kaggle and robinhood had summarized them.

Using the data frame downloaded from those sources, I singled out the American flight companies that existed since 2003 and set the time frame as in between the two periods of SARS and COVID (The tickers of the flight companies are: JBLU (JetBlue Airways Corporation), LUV (Southwest Airlines Co), RYAAY (Ryanair Holdings plc), SKYW (SkyWest, Inc), ULCC (Frontier Group Holdings Inc), ZNH (China Southern Airlines, note: this company is in China but it mainly operates for American customers)).

This project furthermore use S&P 500 index as a parameter to indicate the average market performance as it compares to the airline industry. I mutate the daily change and pivot the data frame so it would appear to use the airline industry as a key so it's more convenient to compare it to the S&P 500 index. I then store the data which uses the flight company stock prices and s&p index as column keys and I could facet with different dates. It also consists of the average change of the day, the open and close price for both stock and s&p index within the column key.

Methods

I decided to perform the analysis for the beginning period of 4 months for both SARS and COVID-19. For COVID-19, I worked with stock prices from 2020-01-03 to 2020-04-01 and for SARS I worked with stock prices from 2002-11-16 to 2003-02-09. I did this because that is when the stock market would be most affected with the changes happening in the world and so many factors playing in at the same time.

After processing the data, I found the % change in daily share prices for both periods. I used a for loop to iterate over the mean stock price columns in which I calculated the percent changes. The formula for the percent change on the nth day of the year is:

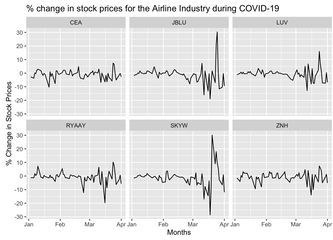
$$p_n = ((c_n - c_1 n - 1)/c_1 n - 1)) * 100$$

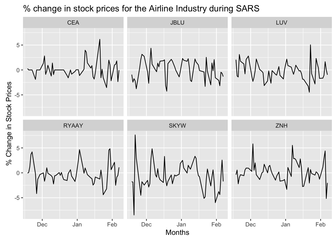
C_n is the stock mean price for the nth day of the year.

I decided to use the stock mean price instead of the closing price to give a better representation of and account for how volatile the stock prices were on that particular day. When calculating the percentage change in stock prices, I used the lag function. The lag function is useful because it shifts each value in a vector down by one. I found NA values for the date of 2002-11-15 because it was the first day for which I obtained the mean stock price data. It being the first day, I could not calculate a percentage change using the prior day's price, and hence I decided to remove it from the dataset.

I then visualised this for the time period of 4 months for both the SARS and COVID-19 pandemics. I used a line plot and facet wrap to visualise volatility for different airlines for both SARS and COVID. A flatter plot signifies lower volatility. Hence, comparing the plots for both the pandemics gives us an idea of how the volatility of stock prices for the airline industry contrast with each other.

Plots





After the visualisation, I calculated the standard deviations for each airline. For this, I grouped the data by the airline and then found the standard deviation. I then arranged the standard deviations in descending order so that the airline with the highest volatility is displayed at the top, and from this we find that both, during SARS and COVID-19, SkyWest, Inc. had the highest standard deviations.

Standard Deviations

- The first table summarises standard deviations of the airlines for the COVID-19 pandemic.

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
## # A tibble: 6 x 2
##   Airlines `Standard Deviation of % Change`
##   <chr>                                <dbl>
## 1 SKYW                                 7.41
## 2 JBLU                                 6.91
## 3 RYAAY                                4.33
## 4 LUV                                  4.13
## 5 ZNH                                  3.78
## 6 CEA                                  3.15
```

- The second table summaries standard deviations of the airlines for the SARS outbreak.

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

```
## # A tibble: 6 x 2
##   Airlines `Standard Deviation of % Change`
##   <chr>                                <dbl>
## 1 SKYW                                 2.76
## 2 ZNH                                  2.01
## 3 JBLU                                 2.01
## 4 RYAAY                                1.93
## 5 LUV                                  1.77
## 6 CEA                                  1.58
```

This showed that both the outbreaks had similar effects on the Airlines Industry as a whole. But I was not sure if that really was the case. I further decided to calculate volatility as the beta values which would essentially show the change in the stock indices with respect to the change in the whole stock market. I used the data from the stock of S&P500 for this.

I used Regression Analysis to calculate the Beta. Beta measures stock volatility, the degree to which price fluctuates in respect to the change in the market. It compares the change of a stock's market compared to other stocks. The beta value measures mean the following:

- Greater than one means that the Airline industry stocks didn't shift with respect to the change in the market; hence the security price tends to be more volatile than the market.
- Less than one means that the Airline industry stocks did shift with respect to the change in the market; hence the security price tends to be less volatile than the market.
- Zero means the airline industry stocks remains unchanged regardless of which way the market moves.

The formula for beta is: Beta = Covariance/Variance

Linear Models

- The following is a linear model for COVID-19 pandemic.

```
## MODEL INFO:
## Observations: 372
## Dependent Variable: COVID$Change_in_stock
## Type: OLS linear regression
##
## MODEL FIT:
## F(1,370) = 202.84, p = 0.00
## R² = 0.35
## Adj. R² = 0.35
##
## Standard errors: OLS
## ------------------------------------------------------------
##                                Est.   S.E.   t val.      p
## ------------------------------ ------ ------ -------- ------
## (Intercept)                    -0.49   0.22   -2.26   0.02
## COVID$Change_in_market          1.09   0.08   14.24   0.00
## ------------------------------------------------------------
```

- The following is a linear model for SARS outbreak.

```
## MODEL INFO:
## Observations: 336
## Dependent Variable: SARS$Change_in_stock
## Type: OLS linear regression
##
## MODEL FIT:
## F(1,334) = 28.80, p = 0.00
## R² = 0.08
## Adj. R² = 0.08
##
## Standard errors: OLS
## ------------------------------------------------------------
##                                Est.   S.E.   t val.      p
## ------------------------------ ------- ------ -------- ------
## (Intercept)                    -0.04   0.11    -0.37   0.71
## SARS$Change_in_market           0.58   0.11     5.37   0.00
## ------------------------------------------------------------
```

Beta Values

- The following value obtained is the Beta value for the COVID-19 pandemic.

```
## [1] 1.088052
```

- The following value obtained is the Beta value for the SARS outbreak.

```
## [1] 0.5757143
```

Results

The graphs that represent the change in the stock indices seem very similar to each other, signifying that both the stocks reacted similarly during both the outbreaks. I further looked at the standard deviation of change and they showed different results.

The betas values essentially showed the change with respect to the market as a whole. We get different results which indicates that the industry was much more volatile during COVID than it was during the SARS outbreak.

Beta values can confirm this; The beta value of the Covid pandemic came out to be 1.088052, which is greater than one, indicating that the stocks were more volatile than the market. In contrast, the SARS beta value was 0.5757143, between 0 and 1, showing that it is less volatile than the market.

Conclusions

With the change in market we could say that the airline industry reacted similarly during both the outbreaks but when we really look into it that is not the case. There are different ways to calculate the volatility but almost all of the ones used here gave similar results. The industry showed a much lower standard deviation in change of indexes during the SARS outbreak compared to the COVID outbreak. The beta value of stocks during SARS was also much lower than the beta of the stocks value during COVID. This essentially means that while the stocks were affected due the outbreak, the change was not as much as the whole change in market and the industry was much less volatile during the SARS outbreak. This could be credited to various factors such as length of the outbreak, how contagious it was, how other countries reacted to it. The travel restrictions could have also played a huge role in it.

Airline stocks fluctuated by a lot during covid, which could be due to stricter lockdown policies across the world, causing the airline industry to suffer more. Among all the airlines, Skywest had the most significant change in the stock price, with the highest peak and trough in the Covid pandemic. Compared to the COVID outbreak, variations during the SARS outbreak stock price were small mainly because measures taken to control the SARS pandemic were less intense.

References

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