Measuring the differences in the volatility of Dow component equities in the pre and post-COVID-19 pandemic

Alan F. Chow
Associate Professor of Quantitative Methods
Mitchell College of Business, University of South Alabama
United States

Kyle Ackerman
Computer Science Major, Samuel Ginn College of Engineering
Auburn University
United States

Gwendolyn Pennywell
Associate Professor Finance
Mitchell College of Business
University of South Alabama
United States

Abstract

The COVID-19 pandemic not only created turmoil in the daily lives of everyone around the world but also created turmoil in the world stock markets. To help understand this turmoil, we studied the six months before March 2020 and the six months after March 2020 to determine if market volatility was significantly different. We used multiple measures of volatility; the variance of the daily returns and the beta of each equity return against three commonly used market measures. We found that while for most DOW component equities, the variances of daily returns differed in the pre and post-COVID-19 periods, the betas relating the equities returns to the measures of the markets were far less changed.

Introduction

The COVID-19 pandemic saw changes in everyday life across the globe. From shortages to lockdowns, the impact is still being felt to varying degrees. As a reaction to the immediate uncertainty, global markets showed significant volatility in March 2020, when the pandemic hit the United States. The S&P 500 index opened the month at about 3000, then dipped mid-month with three successive days with returns of -10%, +9%, and nearly -13%.

More studies are now coming out that have investigated the impacts of the pandemic and its effects on the markets. Albulescu (2021) showed an increase in market volatility related to the number of new cases of COVID-19 in the U.S. Chowdhury, Dhar & Stasi (2022) studied the impact of COVID-19 and changes in economic policy uncertainty on the equity markets in the U.S. Based on their analysis; they surmised that the U.S. markets had greater exposure to COVID-19 than the other world markets.

Engelhardt et al. (2021) found that in a study of 47 national stock markets, the volatility of the market was significantly lower in countries where the citizens had higher trust in themselves and confidence in their country's handling of the outbreak. They concluded that the belief in the country's handling of the pandemic and the citizens' trust in each other to obey the government's guidelines helped reduce the volatility of the markets.

To measure volatility within the markets, we looked to measure the variation of the individual stock returns in the time period before the start of the U.S. pandemic, which we marked as March of 2020. We took the six months of daily returns before March 2020 and the six months after March 2020. In these pre and post-time frames, we measured the variance of the daily returns to test whether the variation of equity returns had changed. We also estimated $\beta\varepsilon\tau\alpha$ for each equity, using three market measures to see if returns of the equities followed the markets in the post-period as it had in the pre-period.

Chow & Lahtinen (2019) measured return volatility using high-frequency data, comparing volatility estimates in time intervals of less than five minutes. Their findings support the idea of using a shorter time period, when available and economical, to estimate realized volatility of returns. For this study, a more efficient approach was to utilize the daily returns and forgo the precision of high-frequency returns in exchange for a quick and efficient review.

Lahtinen, Lawrey, & Hunsader (2018) point out that the concept of measuring beta creates confusion and controversy. They point out that on a given day, the beta estimate of a given stock can have many values depending on how the beta estimates are calculated. Different financial sites measure beta in different ways, using different time intervals, timelines, and market measures. With this in mind, we estimate the beta based on several market measures, though, in this study, we did not look at using different time intervals.

Methodology

Data for this study were downloaded from the Yahoo Finance website and consisted of the daily prices for each of the 30 Dow Jones Industrial Average component equities. Daily returns were calculated for the six months before March 2020 and six months after March 2020. The month of March 2020 was omitted as it was used as the point in time that the COVID-19 pandemic emerged in the United States. Returns were calculated as suggested by Hansen and Lunde (2005) using a log based method as

$$R_t = log \frac{P_t}{P_{t-1}} \qquad (1)$$

To test whether the variance of the daily returns for each equity had changed in the pre to post COVID-19 period, an F-test as $\alpha = 0.05$ was conducted to test the null hypothesis that the variances on the pre and post periods were equal. We also tested the variances of each of the three market measures to see if their returns also changed significantly in the pre and post-periods.

The daily returns were then regressed against three market indices, S&P 500, NASDAQ, and Russell 2000. The beta for each measure of the market indicates the relationship between the return of the equity and the return of the market. We compared the beta of each equity in the pre-COVID-19 period with the beta calculated in the post-COVID-19 period for each market measure. A t-test at the $\alpha = .05$ level of significance was used to test the null hypothesis that the beta for the given equity did not change from the pre to post-COVID-19 periods. Separate t-tests were conducted for each of the beta measures for each market index and each equity.

Results

As reported in Table 1, 27 of the 30 Dow Component equities had a significant change in the variance of the daily returns between the pre and post-COVID-19 periods. This is not surprising based on Albulescu (2021) stating that the overall market saw an increase in volatility during the immediate months following the start of the pandemic in the U.S. The F-tests for each of the market measures also revealed that the markets had significantly different variances in the pre and post-periods, again supporting the early findings of Albulescu (2021).

Conversely, less than half of the stocks had a significant change in the beta when regressed with the Russell 2000. The beta associated with the S&P 500 had even fewer significant differences, and those related to the NASDAQ had only three equities with substantial changes in beta. These findings are not overly surprising since we expected most of the volatility seen to be in the fluctuation of the daily returns. Additionally, the returns of the equities mostly fluctuated similarly to that of the market measures. Since the beta is the measure of how the stock relates to the market, these results are not surprising.

Table 1 – Summary of test results over all 30 Dow Component Equities

Comparisons Pre and Post COVID	Total Significant at p=0.05
F-test on Variances of equities Pre & Post	27 of 30
F-test on Variances of market measures	3 of 3
T-Test Differences in equity Beta on Russell 2000	14 of 30
T-Test Differences in equity Beta on S&P500	9 of 30
T-Test Differences in equity Beta on NASDAQ	3 of 30

Interestingly, the three equities that did not significantly change in variance between the pre and post-periods were Johnson and Johnson, Proctor and Gamble, and United Health Groups. According to its website, Johnson and Johnson is the "world's largest and most broadly-based health care company." Proctor and Gamble is a multinational consumer goods company making items in health care, fabric and home care, beauty, grooming, and family care products. United Health Group says they are a "health and well-being company." The three companies that did not have significant differences in their variances were all in the areas in some way of providing products and services to help consumers stay healthy.

Conclusions

While our study only looked at a small portion of the overall U.S. market equities, the findings support previous studies related to the market volatility during the COVID-19 pandemic. Variation in daily returns was significantly different for most equities, while most equities maintained their relationship with the markets as measured by their betas. Again, the betas tested in this study only used daily returns and a relatively short time period, so further studies should be done with longer time periods and more extended return periods.

References

Albulescu, C.T. (2021). COVID-19 and the United States financial markets' volatility. *Finance Research Letters*, 38, 1 – 5.
Chow, A.F. & Llahtinen, K.D. (2019). Equity Risk: Measuring return volatility using historical high-frequency data. *Studies in Business and Economics*, 14(3), 60 – 71.
Chowdhury, E. K., Dhar, B. K., & Stasi, A. (2022). Volatility of the U.S. stock market and business strategy during COVID-19. *Business Strategy and Development*, 1 – 11.
Englehardt, N., Krause, M., Neukirchen, D., & Posch, P.N. (2021). Trust and stock market volatility during the COVID-19 crisis. *Finance Research Letters*, 38, 1 – 6.
Lahtinen, K.D., Lawrey, C.M., & Hunsader, K.J,. (2018). Beta dispersion and portfolio returns. *Journal of Asset Management*, 19, 156 – 161.