COVID-19 Pandemic and the 2020 March U.S. Stock Market Crash

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Introduction

In 2020, the world was thrown into chaos through an ongoing pandemic because of a virus known as "Covid 19" or the coronavirus. This impacted the economy, businesses, and the citizens all around the world negatively. This caused a variety of troubles such as the Russia and Saudi Arabia oil price wars, state lockdowns, travel bans, unemployment rate increase, T-bills yield curve lowered, oil price decrease, and the 2020 stock market crash. As the world was figuring out a vaccine to the virus, the world implemented restrictions, bans, closedowns, and other ways to reduce the spread by limiting interactions. The virus affected many businesses so companies had to fire/layoff most of their employees. This also raised concerns for investors and their financial future which ultimately resulted in the 2020 stock market crash, although this only lasted for a short period of time.

While the pandemic started to worsen in 2020 the oil industry faced a significant price drop due to the export/import bans and limitations which created a surplus in products. Russia and Saudi Arabia started an oil price war because the prices were continuing to drop and everyone was worried about maintaining the supply. Since there were bans and limitations, the demand for oil was less than the supply and the production of oil kept increasing. Just like what happened with the milk industry when Trump started a trade war with China, there was a surplus in supply but not enough sales to maintain the supply/demand. Therefore, the price had to be lowered so the excess oil could be sold fast. However, the effects of the virus worsened the situation with oil and the prices dropped to a negative price. This situation was getting out of hand so there was a meeting to form the OPEC+ alliance which is an agreement to reduce and slow down oil production because production can not be stopped. Other oil companies were impacted too, for example, Brent oil, Crude oil, Whiting Petroleum, & BP. Whiting Petroleum Corporation ended up filing for bankruptcy on April 1, 2020.

The productivity across the country was in a decline and when the businesses suffer so do the employees of these businesses. The United States unemployment rate rose to 3.6% due to the rise of virus cases and many people struggled to pay rent, buy food, and pay other utilities. The decrease in productivity scared the investors because the stock prices and market were also declining. Then in March 2020, the stock market crashed, causing Dow Jones and S&P 500 to drop. The stock market crash occurred on March 9, 12, and 16. Dow Jones dropped 2,013.76, 2,352.60, and 2,997.10 points, respectively. Meanwhile, S&P 500 index dropped 7%, 13%, and 20%. The long term T-bills yield curve was also negatively affected by the 2020 stock market crash. The 10 year notes fell 0.76% and the 30 year notes fell 1.38% after March 9 and 12. Some investors did sell their stocks while others kept their investments and invested in short term T-bill notes. As the demand for short term bills increased and the yield dropped, this encouraged investors to demand a higher yield than the long term T-bills for the short term bonds/T-bills.

Our group collected the data for each Stock/Index prices so we can analyze the changes in prices throughout the year before and after the 2020 stock market crash. We will be finding

the Beta, Average monthly return and standard deviation, Standard deviation, Variance, Risk-free rate which is the yield on long term T-bills, Sharpe ratio, and Reward-risk ratio.

Data Analysis

In order to analyze the impact of the COVID-19 pandemic on the 2020 March U.S. stock market crash, indexes (Dow Jones Industrial Average, S&P 500, and TOPIX), stocks (Crude oil WTI, Brent oil, Whiting Petroleum Corporation, BP), and US Treasury bills data will be utilized. These data are selected for specific reasons. Firstly, Dow Jones measures the daily stock market movements of 30 U.S. publicly-traded companies listed on the NASDAQ or the New York Stock Exchange (NYSE), making it a good indicator of general market trends. Similar to Dow Jones, S&P 500 encompasses 500 American companies and it is also widely analyzed by market analysts. The TOPIX index for Japan is also included in order to grasp an understanding of how the U.S. stock market crash may have influenced foreign stock markets. Additionally, crude oil WTI are oil stocks traded in the U.S. market, Brent oil are traded in the Europe stock market. These two major stocks are indicators of oil price and stocks and often analyzed by financial analysts. Also, individual oil stocks Whiting Petroleum Corporation (WLL) and BP's individual performance during the crash will be determined and compared (because WLL filed for bankruptcy). Lastly, US Treasury bills are utilized as risk free rate.

The following **Table 1** depicts the closing prices for indexes and stocks on major days March 9, 12, and 16th and their previous stock trading day (for percentage change calculations). On the major days, U.S. stock market indexes such as Dow Jones and S&P 500 dropped and triggered a circuit breaker. The circuit breaker stops trading on an exchange in an attempt to curb panic-selling. All indexes and stocks experienced major decline. The TOPIX index in the Japan stock market was also influenced but to a smaller degree.

Table 1

Closing Price ($) for Indexes and Stocks on March 6, 9, 11, 12, 13, and 16th

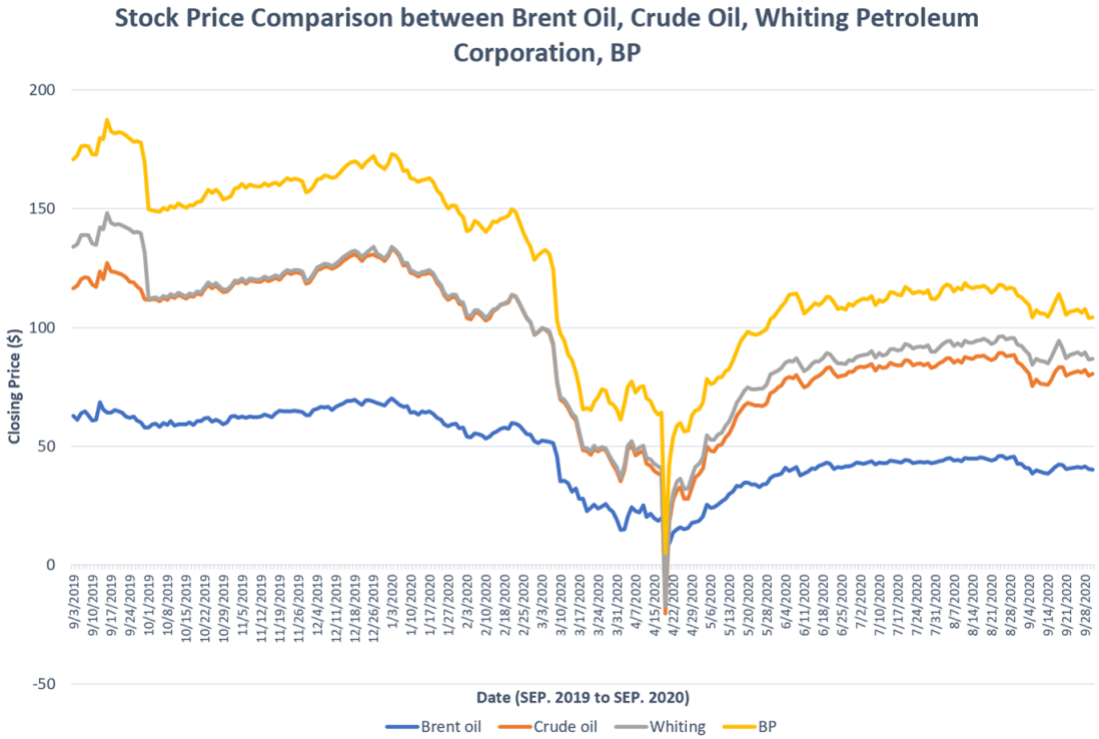
Date\Closing Price ($)	DJIA	S&P500	TOPIX	Crude Oil	Brent Oil	WLL	BP
03/06/2020	25864.78	2972.37	1471.46	41.28	45.60	1.33	45.60
03/09/2020	23851.02 (-7.79%)	2746.56 (-7.60%)	1388.97 (-5.61%)	31.13 (-24.59%)	35.33 (-22.52%)	0.80 (-39.85%)	35.33 (22.52%)
03/11/2020	23553.22	2741.38	1385.12	32.98	34.45	0.82	34.45
03/12/2020	21200.62 (-9.99%)	2480.64 (-9.51%)	1327.88 (-4.13%)	31.50 (-4.49%)	31.02 (-9.96%)	0.75 (-8.54%)	31.02 (-9.96%)
03/13/2020	23185.62	2711.02	1261.70	31.73	32.25	1.30	32.25
03/16/2020	20188.52 (-12.93%)	2386.13 (-11.98%)	1236.34 (-2.01%)	28.70 (-9.55%)	27.98 (-13.24%)	1.37 (5.38%)	27.98 (-13.24%)

*Note: Data are adapted from Yahoo Finance.

Similar individual stock market price trends may be observed in the following **Figure 1**.

Figure 1

Stock Price Comparison between Brent Oil, Crude Oil, Whiting Petroleum Corporation, BP from SEP 2019 to SEP 2020



*Note: Data are adapted from Yahoo Finance.

The above figure only indicates similar patterns in stock price. Therefore, in order to gain an in-depth understanding of each stock, Beta (measuring a stock's volatility/risk), Sharpe ratio, and Reward-risk ratio will be computed and analyzed. Calculators and excel sheets are used, and the following formulas will be utilized for calculation:

Average Monthly Return: $\sum Expected\ Monthly\ Return$

*Note: Both average and expected monthly returns are computed through excel sheets

Average Monthly Standard Deviation: $\sum Expected\ Standard\ Deviation$

*Note: Both average and expected standard deviation are computed through excel sheets

Beta: $$\beta_s = \frac{Cov(r_s, r_m)}{Var(r_m)}$$

Where r_s = return on the stock, r_m = return on the market, $Cov(r_s, r_m)$ = covariance of the stock and the market, and $Var(r_m)$ = variance of the market.

Sharpe Ratio: $$\frac{E(R) - rf}{\sigma}$$

Where E(R) - rf = risk premium, σ = standard deviation

Reward-risk Ratio: $$E(R_A) = R_f + \beta_A \times [E(R_M) - R_f]$$

Where R_f = risk-free rate, B_A = beta for firm A, $E(R_M) - R_f$ = market risk premium

Table 2

Average monthly return and standard deviation for Dow Jones, S&P500, WTI, Brent Oil, WLL (no outlier), and BP from SEP 2019 to SEP 2020

	Average Monthly Return	**Average Standard Deviation**
Dow Jones	0.52%	7.16%
S&P500	1.25%	6.83%
TOPIX	0.47%	6.16%
Crude Oil (WTI)	1.15%	30.47%
Brent Oil	0.29%	28.60%
WLL (no outlier)	-11.01%	37.81%
BP	-4.96%	10.09%

*Note: WLL emerged from bankruptcy, thus its stock price increased dramatically in September 2020. Therefore, the data for WLL in SEP 2020 considers an outlier and will be excluded.

Table 3

Beta for stocks Crude Oil (WTI), Brent Oil, WLL (no outlier), and BP

	Dow Jones	**S&P500**
Crude Oil (WTI)	2.31	2.44
Brent Oil	2.39	2.50
WLL (no outlier)	3.14	3.18
BP	1.29	1.34

*Note: WLL emerged from bankruptcy, thus its stock price increased dramatically in September 2020. Hence, data for WLL in SEP 2020 considers an outlier and will be excluded.

Table 4

Sharpe ratio for stocks Crude Oil (WTI), Brent Oil, WLL (no outlier), and BP

	Risk Premium (2020 Rf rate) %	**Standard Deviation %**	**Sharp Ratio**
Crude Oil (WTI)	0.79	30.47	0.026
Brent Oil	-0.07	28.60	-0.0024
WLL (no outlier)	-11.37	37.81	-0.3007
BP	-5.32	10.09	-0.53

*Note: U.S. treasury bills data is used as 2020 risk free rate. Data was obtained from the U.S. Department of the Treasury.

**Note: WLL emerged from bankruptcy, thus its stock price increased dramatically in September 2020. Hence, data for WLL in SEP 2020 considers an outlier and will be excluded.

Table 5

Reward-risk ratio for stocks Crude Oil (WTI), Brent Oil, WLL (no outlier), and BP

	Beta (S&P500)	**Market risk premium (S&P500)**	**Reward-risk ratio (2020 Rf rate)**
Crude Oil (WTI)	2.44	0.89	2.53
Brent Oil	2.50	0.89	2.59
WLL (no outlier)	3.18	0.89	3.19
BP	1.34	0.89	1.55

*Note: S&P 500 index will be utilized as the market index because it includes more companies than Dow Jones Industrial Average.

**Note: U.S. treasury bills data is used as 2020 risk free rate. Data was obtained from the U.S. Department of the Treasury.

***Note: WLL emerged from bankruptcy, thus its stock price increased dramatically in September 2020. Hence, data for WLL in SEP 2020 considers an outlier and will be excluded.

From **Tables 2, 3, 4, and 5**, we may further analyze the indexes/stocks in addition to comparing their closing prices. Average monthly return indicates each stock's potential profitability. S&P500 exhibits the greatest return of 1.25%, followed by Crude Oil (WTI) with

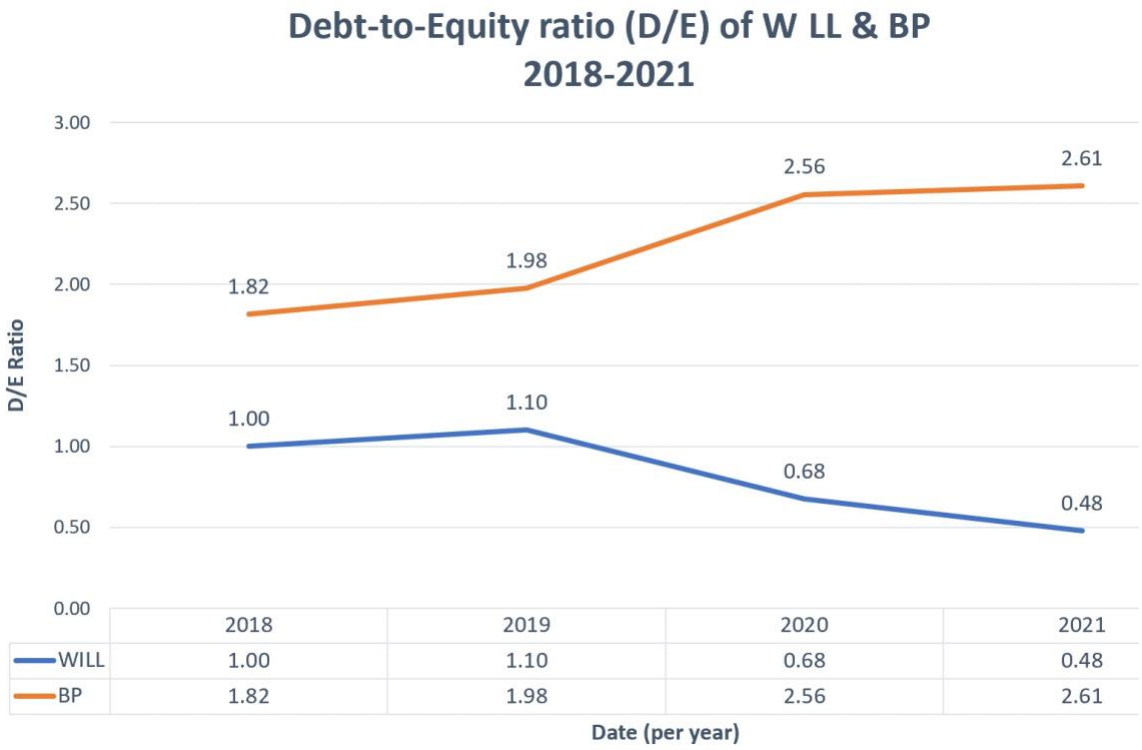
1.15%. Despite the 0.10% difference, S&P500 manifests an average monthly standard deviation of 6.83% and Crude Oil with 30.47%. The standard deviation measures each stock's volatility and risk. It seems like S&P500 has a lower risk and a higher return. Reward-to-risk ratio is therefore computed to determine the potential reward for every dollar one risks. The S&P500 index is used as the market measure, and the results reveal that WLLhas the greatest reward-risk ratio. However, if were to compare WLL's average monthly return and standard deviation, it may be understood that WLL has a relatively high risk (i.e., standard deviation was 37.81%, also indicates high risk). On a holistic view, Sharpe ratio suggests the performance of a stock in comparison with risk-free assets (U.S. T-bills rate of 2020). From the results, Crude Oil (WTI), Brent Oil, WLL, and BP both had a Sharpe ratio below 1, meaning the stock's performance may be considered as not worth of investing. Only Crude Oil (WTI) had a positive Sharpe ratio. Lastly, Beta measures the systematic risk of a stock compared to the market as a whole (where market Beta is 1). The results indicate WLL has the greatest Beta, potentially due to its struggles in risk management when encountered the March 2020 stock market crash.

To better understand why WLL filed for bankruptcy while BP remained relatively stable during the stock market crash, the debt-to-equity ratio of the companies will be computed. Their capital structure may reveal potential reasons behind the difference in vulnerability when facing stock market risk event. The following formula will be used:

$$Debt\ to\ Equity\ Ratio = \frac{Total\ Liabilities}{Total\ Shareholders'Equity}$$

Figure 2

Debt-to-Equity ratio (D/E) of WLL & BP from 2018 to 2021



*Note: Data was obtained through public information of WLL and BP's balance sheet data of total liabilities and total shareholders' equity from the *Wall Street Journals* website.

The D/E ratio reveals how much debt a company is using to finance its assets relative to the value of shareholders' equity. From **Figure 2**, it may be observed that although BP had relatively lower volatility, its D/E ratio increased from 1.98 in 2019 to 2.56 in 2020, and from 2.56 to 2.61 in 2021. This information may be implying that BP may have borrowed more money in order to overcome and cope with the stock market crash crisis. On the other hand, WLL filed for bankruptcy in 2020, thus their D/E ratio dropped as they attempted exit bankruptcy by erasing debt and in exchange of equity.

Results

From the Data Analysis, the results from the calculations computed may have some implications to the stock market crash and its aftermaths. U.S. stock market index indicators Dow Jones Industrial Average (DJIA) and S&P500 have been negatively

Conclusion

The volatility of a stock can be determined by calculating the Beta of all these oil stocks with the U.S stock index. Before we can get the Beta we used excel to get the standard deviation and variance. With the risk-free rate that we got from the long term T-bills we calculated the

Sharpe ratio and reward-risk ratio to see if these stocks are worth investing in. As for the monthly average and average monthly standard deviation we used monthly data of the closing prices. The pandemic affected many sectors of the economy, especially the oil industry. Other than these stocks, index, industry, the government bonds(Treasury bills) were negatively impacted. The long term Treasury bills yield fell around 1-2% when the 2020 stock market crashed while investors demanded more for the short term Treasury notes. As the pandemic cases worsened, we can see a continuous declining trend of the stock and index prices, and government bonds but prices hit its lowest point in March.

In order to keep investors, business owners, and the citizen's calm, the government issued stimulus packages and other financial support. With the help of Federal Reserves from other countries this was possible for the U.S to stimulate their economy. Many Federal Reserves from around the countries repurchased U.S bonds, provided loans, and lower reserve requirements to zero. The United States passed three stimulus checks for its citizens, the first one was for "$1,200 per adult and $500 per child under 17 years old". The second stimulus check was for "$600 per eligible family member, $1,200 for married filing joint returns and $600 per dependent child under 17". The last stimulus check was for "$1,400 for individuals or $2,800 for married couples, plus $1,400 for each dependent". In addition to these stimulus checks, those who were unemployed received financial assistance from the government while business owners were given loans to operate their businesses. Along with the financial support from the government, the economy benefited from the investors continuing their investments and investing in short term T-bills instead of selling their stocks. As a result, the 2020 stock market crash lasted for a short time, which was a short recession then the stock market saw a boom in the summer/fall. This also helped the stock prices, indexes, and Treasury bills to increase. The Whiting Petroleum Corporation was later merged with Oasis Petroleum with a $6 million deal. The vaccines that were produced also helped ease the mind of everyone, even though the process of getting these vaccines to everyone was slow.

Overall the coronavirus made a huge negative impact on the economy all around the world, however, through financial help from Federal reserves, loans, and lowering reserve requirements this stimulated the economy and improved the stock prices, indexes, and government bonds. The negative impact of the virus was countered by receiving financial help and the knowledge that people are safer with the vaccines. In addition, with the vaccine people were safer and more people could start working again, therefore, increasing productivity. By circulating funds to the people, this increased spending which also helped businesses, investors, the government, and other countries. Another important factor in this 2020 stock market crash was the fact that the investors did not panic sell their stocks which would make the recession last longer and prices to continue to decrease. We can all see that by easing everyone's fear and providing the necessary assistance we can come together to pick ourselves up from the economic crisis. There is a saying that having a calm mind, it will help people make better decisions.

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