 # Group 7-Project-1-Covid-Recovery

Project Title: Comparing Sector Performance Pre- and Post-COVID: A Study of the S&P 500

Project Description:

This project aims to evaluate the performance of four major sectors within the S&P 500 — Technology, Healthcare, Energy, and Financial — before and after the COVID-19 pandemic. The analysis will highlight the similarities and differences between the sectors and draw conclusions about which sectors were more resilient or volatile during these periods.

The relevant data was fetched via the Alpha Vantage API and then cleaned to reflect the time-period in question of January 2017 till December 2023.

The question under the spotlight for this analysis is:

<u>What were the key differences in the recovery patterns of these sectors post-COVID?</u>

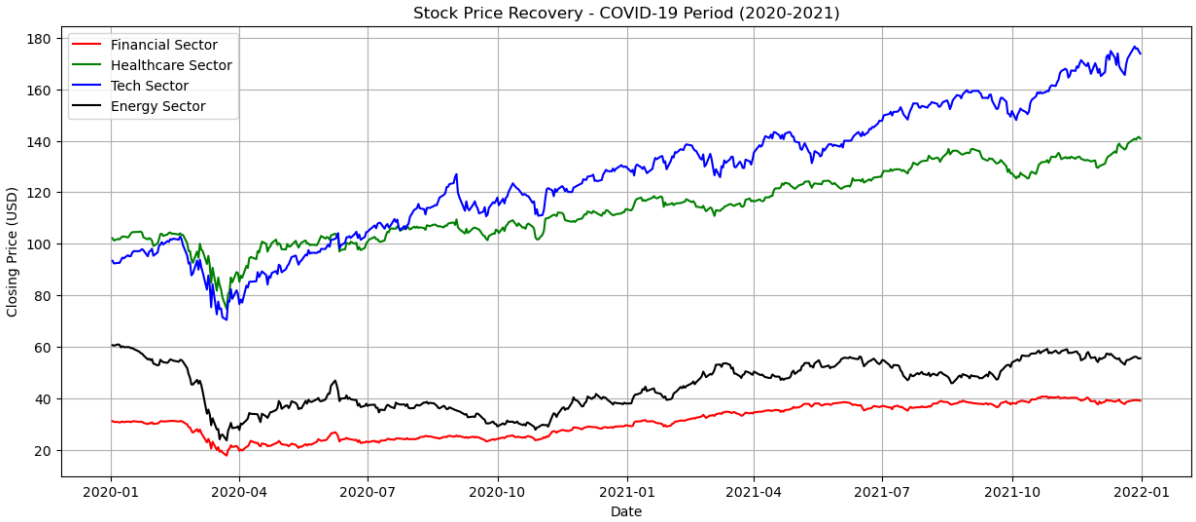
The appended analysis therefore specifically focuses on the key differences in the recovery patterns of the Financial, Healthcare, Technology and Energy sectors in the direct aftermath of COVID.

Therefore, the data was cleaned and filtered for January 2020 - December 2021, as these dates best reflect the time-period in question, where the initial crash due to COVID lockdowns and recovery during the COVID period can be visualised and analysed.

Graphical and Visual Analysis

Some initial line charts were made for the individual sectors, where the closing price is plotted across both the entire 2017 - 2023 and the focused 2020 - 2021 time periods. These were plotted for all sectors, simply to sense-check the data pulled from the API, the accuracy of the coding to clean and filter the data and to gain a general understanding of the industry trends at a glance.

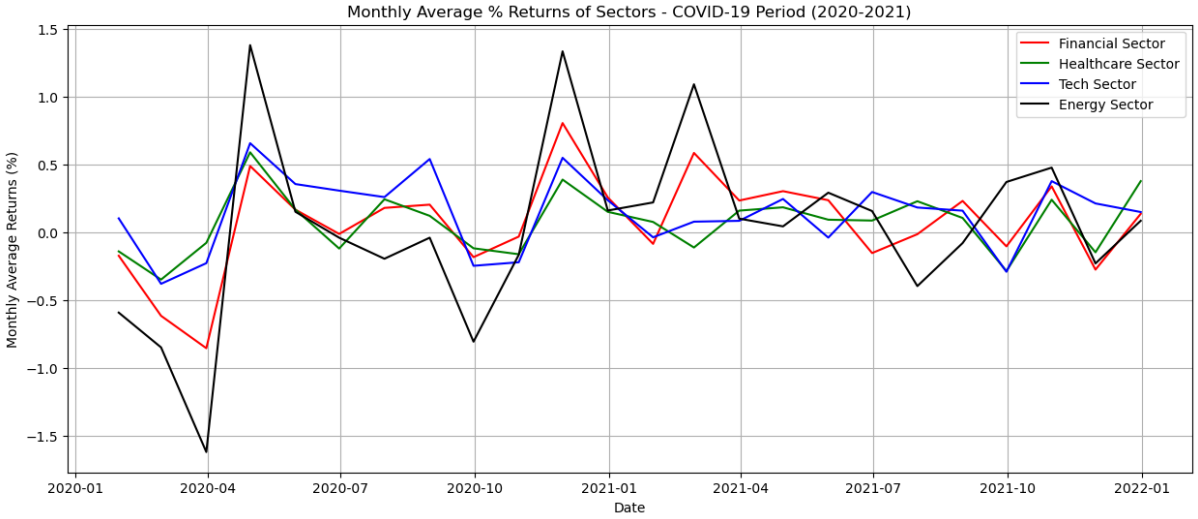
Ultimately, the individual charts for the 2020 – 2021 time-period in question were combined into the 'Stock Price Recovery - COVID-19 Period (2020-2021)' chart below.



This chart crucially presents the performance of all 4 sectors by showcasing the pre-crash closing prices at the start of the year, the impact of the COVID crash in the initial lockdown

stages, and the recovery process till the end of 2021. These elements across this time-period form the basis of the study. It also provides depth in the individual industries, showing Tech stocks and Healthcare stocks were already valued higher, and went on to achieve even greater recoveries as the year progressed.

Next the % returns were calculated for the four sectors, but due to the volatile nature of the industry these could not be effectively plotted in a daily or even weekly format. Therefore, Monthly Average % returns were calculated and plotted in the 'Monthly Average % Returns of Sectors - COVID-19 Period (2020-2021)' graph below.



This graph provides a useful indication of the volatility in the different sectors, and the Energy Sector visibly stands out as the most volatile sector in terms of monthly % returns. The Financial sector can be identified as the second most volatile sector, with more stable returns being observed for the Tech and Healthcare sectors.

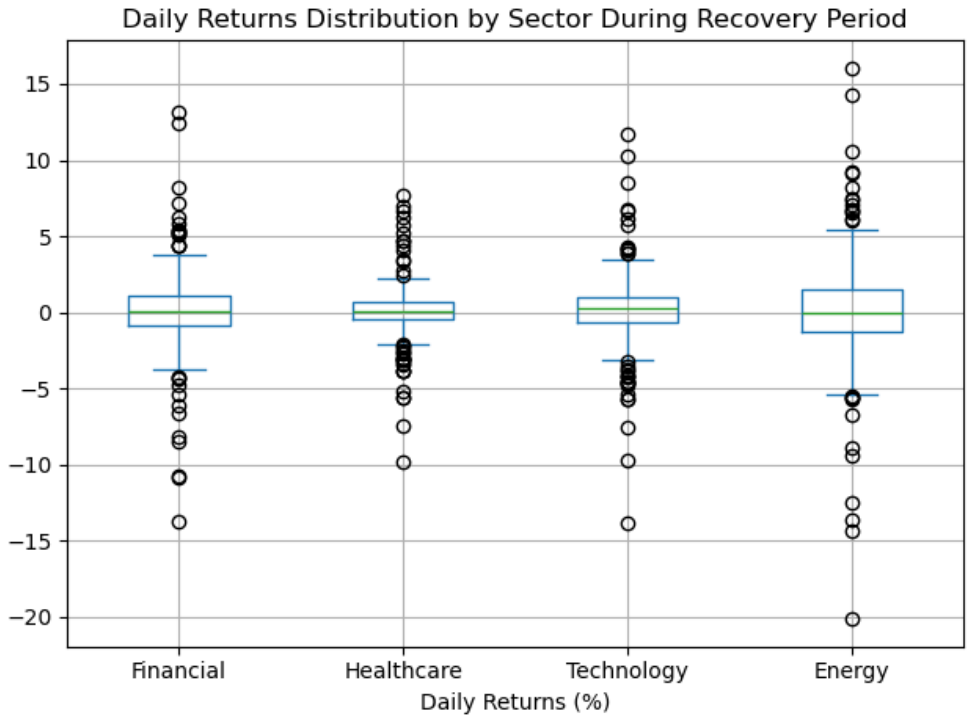
To further analyse sector volatility and highlight recovery patterns, further analysis was done on the volatility using a box plot for the % returns.

It can also be observed from the box plot below that the median values for all sectors are close to zero, indicating very little returns in the recovery period. However, this is also a common phenomenon in the stock markets, due to their volatile nature.

The Energy sector has the widest interquartile range (IQR), indicating greater volatility. And the Healthcare sector has the narrowest IQR, indicating the healthcare sector experienced the least volatility.

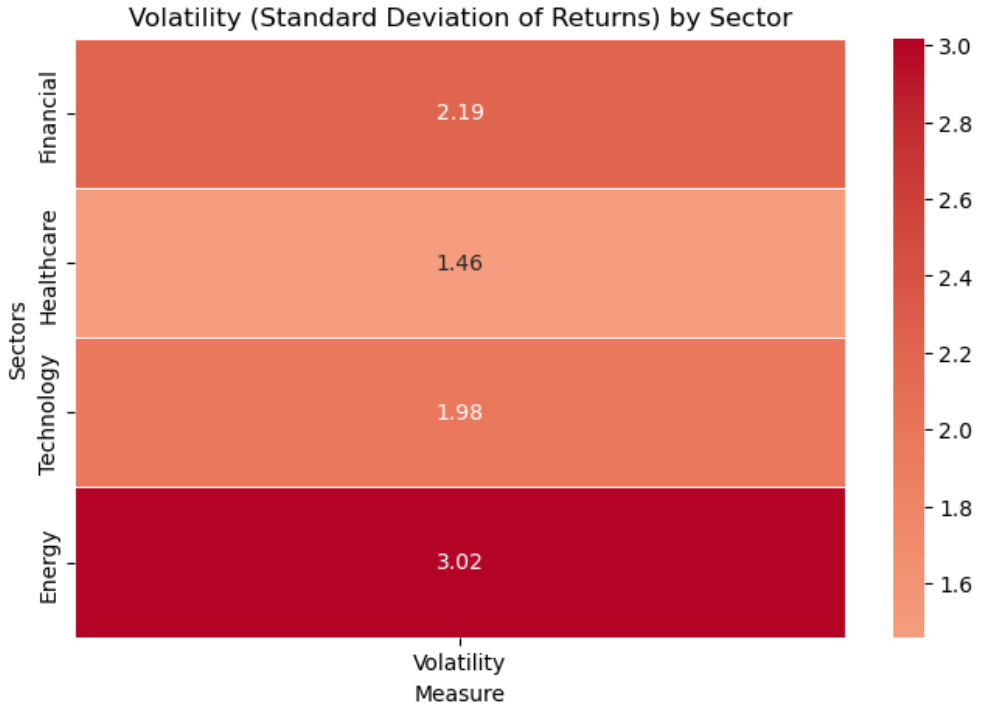
All four sectors exhibit a significant number of outliers, however the Energy sector seems to have the largest outliers. The box plot below clearly shows the Energy Sector having the largest outliers, and therefore supports the observation from the monthly returns line chart above.

Crucially, the box plot also shows us that even though the Healthcare and Technology sectors had the narrowest IQRs, all sectors had a number of outliers, therefore indicating a sizeable degree of volatility in all sectors. However we can conclude from the box plot that the Energy and Financial sectors were the most volatile, and the Healthcare and Technology sectors were relatively stable.

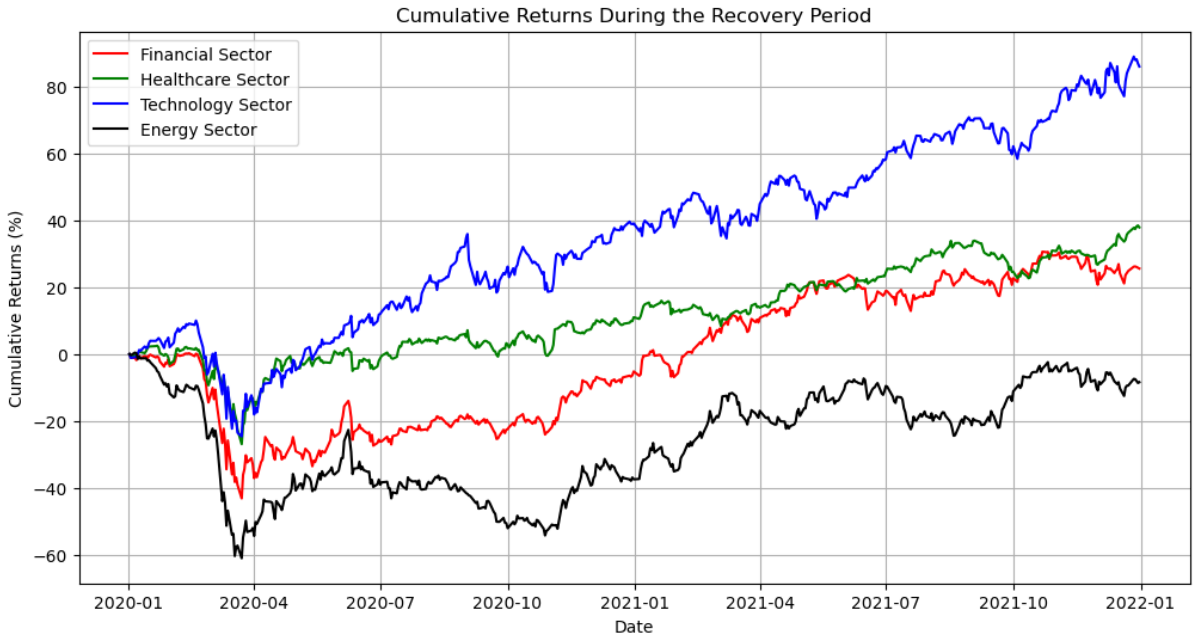


In order to further visualise the degree of volatility, the 'Volatility (Standard Deviation of Returns) by Sector' heatmap chart was made. The heatmap below was compiled by calculating the standard deviations of the % returns of each sector, in order to quantify and showcase sector volatility.

This heatmap confirms our earlier observations, as with a standard deviation of 3.02, the Energy sector clearly had the highest degree of volatility. In contrast, the Healthcare sector also had the least volatility, with a significantly lower standard deviation of 1.46. The Financial and Technology sectors had relatively median levels of volatility, however the Energy sector is once again a clear outlier.



Next the 'Cumulative Returns During the Recovery Period' chart was created to showcase the cumulative % returns of the 4 sectors, across the same time period. This chart is useful for showcasing which sector grew the most during the recovery period, and thus had the strongest recovery in the aftermath of COVID.



The chart above clearly shows us that all sectors experienced a sharp drop at the start of the pandemic, but once again the Energy sector stands out as having the sharpest drop. This is symptomatic of financial turbulence, as recessionary pressures can reduce consumption and production, leading to reduced demand for energy resources. As a result, the Energy sector had negative returns of approximately -10% by the end of 2021.

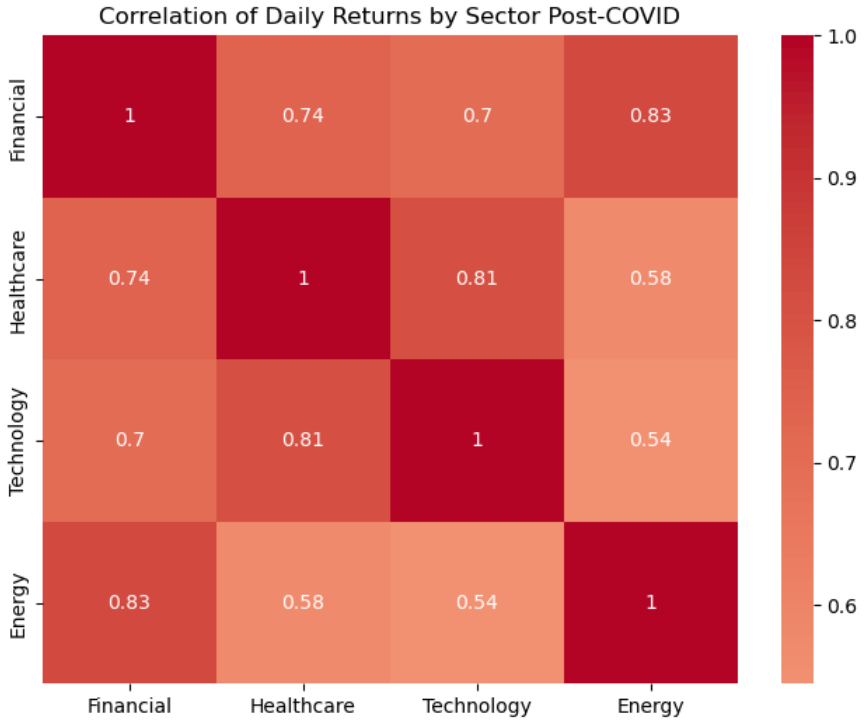
Another important observation is that the Tech sector experienced the strongest recovery, with cumulative returns exceeding 80% by the end of 2021. This also aligns with the increased demand digital services and remote working solutions during the pandemic.

After the tech sector, the Healthcare sector experienced the strongest recovery, with cumulative returns of approximately 40% by the end of 2021. This is also likely to have been affected by the increased investment and government grants and funding towards the development of vaccines, medical apparatus/accessories, and overall healthcare services to cope with the pandemic.

The Financial sector also had moderate returns of over 20% by the end of the year, however its initial performance was similar to the Energy sector. This may also be attributed to the recessionary pressures in the economy, as financial and economic uncertainty, unemployment and loan default risks may have exacerbated this.

Correlation Analysis

A correlation analysis was also done to better showcase the recovery patterns of the individual sectors. Once again, the % returns were used in this correlation analysis, to identify any patterns in the performance or recovery of different sectors. The resulting correlation heatmap below shows how closely correlated the recovery of individual sectors may be, due to overlapping factors.



The Energy and Financial sectors were found to be closely correlated, with a correlation of 0.83. This is the strongest correlation relationship in the model and can be explained by the macroeconomic factors driving these sectors. Increased consumption, production and overall demand in an economy is bound to lead to increased demand for energy due to the increased economic activity. This is in line with the earlier observations from the cumulative returns graph. The effects of recessionary pressures and macroeconomic factors in the economy result in a strong correlation between the Financial and Energy sectors. This also explains why both these sectors had the sharpest drop in cumulative returns at the start of the pandemic.

Similarly, the Healthcare and Technology sectors were also found to have a strong correlation of 0.81. This is in line with their performance showcased in the Cumulative returns chart earlier, as having the strongest recoveries in the time period. The strong correlation can also be explained by increased investment government and private investment in health-tec initiatives and digital health solutions during the pandemic and lockdowns.

Finally, though the Energy & Technology and Energy & Healthcare sectors also exhibit a positive correlation of 0.54 and 0.58, respectively, it is not as significant. This indicates that these sectors may have exhibited similar behaviour as the markets fluctuated, but they were not as strongly correlated.

Regression Analysis

Finally, a regression analysis was also done to identify additional patterns between volatility and sector recovery. The variables used were the % returns of the sectors, the initial drop at the start of the pandemic and the recovery time of the stocks.

The initial drop is used to indicate the effect of the stock market crash at the start of the pandemic. Therefore, the lowest datapoint of % returns for each sector was used for this

analysis. And the Recovery time is used to indicate the number of days it took for the % returns to recover back to their pre-crash levels at the start of the year.

OLS Regression Results

Dep. Variable:	Recovery Time	R-squared:	0.905
Model:	OLS	Adj. R-squared:	0.714
Method:	Least Squares	F-statistic:	4.747
Date:	Wed, 23 Oct 2024	Prob (F-statistic):	0.309
Time:	17:16:01	Log-Likelihood:	-22.329
No. Observations:	4	AIC:	50.66
Df Residuals:	1	BIC:	48.82
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-482.1714	258.826	-1.863	0.314	-3770.872	2806.529
Volatility	643.0450	787.509	0.817	0.564	-9363.200	1.06e+04
Initial Drop	44.9553	119.768	0.375	0.771	-1476.845	1566.755

However, the results of the regression were ultimately deemed inconclusive. The primary reason for this is the limitations of the dataset used in this study. Considering this is stock market data, there a number of factors not captured by the current size of the dataset, posing limitations for a regression analysis. This is also the most likely reason the p-values and T values of the regression model were not statistically significant.

A regression analysis with a much larger dataset and significantly greater datapoints may be able provide more useful insights for the sector performance analysis.

Conclusion

In conclusion, the correlation analysis, volatility heatmap, cumulative returns and the other charts are much better indicators of how the different sectors performed in the aftermath of COVID. The primary observations of this analysis are as follows:

- The Energy sector had the highest volatility, the lowest % returns, the longest recovery time and the sharpest drop at the start of the pandemic.
- However, a regression analysis could not be used to effectively assess the relationship between these factors.
- The Energy and Financial sectors were the most closely correlated in performance, owing to the macroeconomic factors and recessionary pressures in the economy.
- However, the Healthcare and Technology sectors exhibited the strongest and fastest recoveries by the end of 2021.
- This was likely affected by government and private initiatives towards treatments and vaccine developments, and overall demand for medical goods and services in an increasingly digital world.

A regression analysis can be done to further examine how the initial stock market crash and volatility can affect the recovery time of the sectors. However that is beyond the scope of the dataset used in this study.