How do the stocks market have performed during the COVID-19 pandemic?

Introduction

The pandemic has had multiple economic impacts around the world. These have been of different magnitude and characteristics for each country and economic activity, as well as the impact has evolved with the development of the pandemic, possibly with an effect of greater magnitude at the beginning of the pandemic compared to today. Understanding the magnitude and direction of the impact allows governments to identify measures, both fiscal and monetary, to avoid an economic crisis; and companies to identify business opportunities or to request for financial support.

In view of the above, this project seeks to differentiate the economic impact of the pandemic by economic activity to identify, specifically:

1. Which economic sectors have had a better/worse performance during the pandemic?
2. Which companies within each sector have had a better/worse performance during the pandemic?
3. Is there a correlation between the COVID cases and stocks performance?

Data

To carry out our analysis, we used the Standard & Poor's stock index of the 500 large companies listed on the New York Stock Exchange or NASDAQ as a measurement variable for economic performance. This index is a leading economic indicator of how well the U.S. economy is doing. The S&P 500 is composed of 11 sectors composed by market-capitalization-weighted companies.
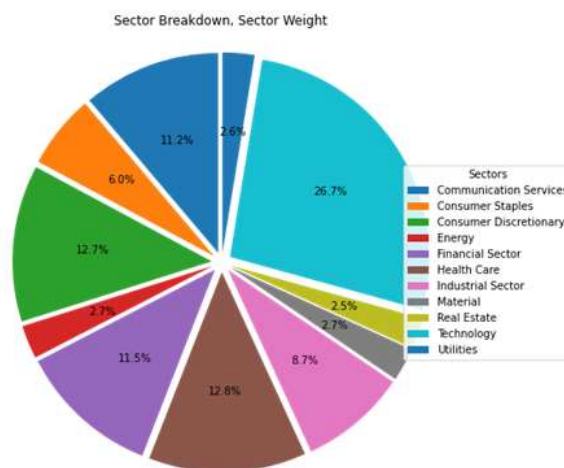
We retrieved the data of the sectors and companies stocks from Alpha Vantage Inc. stock APIs, and from the kaggle.com we retrieved the cumulative COVID-19 cases by country.

We analyse daily stock prices and daily worldwide cumulative cases from January 2020 to January 2021.

Methodology

Our analysis consisted in a graphic visualization of the daily stock prices by sector and companies within each sector to see the performance of these economic activities. The objective of this project was not to do a time series analysis, but to apply python libraries we have worked during the course. Therefore, for this project we used Numpy, json, requests, pandas, matplotlib, scipy, os, datetime, time. Additionally, to evaluate the possible impact of the cumulative COVID-19 cases in the stocks performance, we did a simple linear analysis.

We measure the sector's performance by the average change of the stock prices between January 1st 2020 and January 1st 2021.

To evaluate graphically the response of the market to the evolution of the pandemic, we included in our graphs four relevant events:

- 30/01/2020: The W.H.O. declared a global health emergency
- 11/03/2020: WHO Declares COVID-19 a Pandemic
- 21/07/2020: Phase I/II vaccines' promise results
- 08/12/2020: First coronavirus vaccine approved for use in the U.K.

Results

The Health Care sector (XLY) is the one with the highest price in the S&P 500 index, with an annual mean of $120, but on the other hand with the highest standard deviations, meaning that it has high returns but with a lot of volatility. The Consumer Staples sector (XLP) is the sector with the lowest risk of investment with a 2.6.standard deviation.

	XLC	XLP	XLY	XLE	XLF	XLV	XLI	XLB	XLRE	XLK	XLU
count	253.000000	253.00000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000
mean	51.715534	60.31585	120.570040	48.896601	26.425296	96.800632	73.589802	56.194387	36.872846	89.967628	61.587628
std	3.842267	2.68048	9.686427	11.575149	3.526155	6.105762	8.339901	4.898897	3.121156	9.495023	4.363855
min	40.220000	48.63000	87.450000	23.570000	17.660000	74.620000	48.770000	38.350000	25.460000	70.400000	44.930000
25%	49.580000	58.92000	117.350000	37.450000	23.380000	91.440000	68.290000	54.950000	34.850000	81.460000	58.640000
50%	51.560000	60.78000	121.590000	54.920000	26.960000	98.500000	75.230000	57.530000	38.120000	88.420000	62.560000
75%	54.820000	62.04000	126.340000	59.340000	29.810000	101.750000	81.250000	59.880000	39.190000	97.180000	64.110000
max	58.130000	64.79000	137.360000	63.130000	31.170000	106.880000	85.230000	62.360000	41.930000	110.430000	70.980000

When looking at the sector's performance during 2020, we found that clearly the Technology Sector (XLK) got the best performance during covid-19, which increased its stock prices in 37.4% at the end of the year.

In the contrary, the Energy Sector (XLE) was the sector with the worst performance, with a decrease of 41.2%.

	Ticker	Initial	Final	Percentage Price Change
9	XLK	80.360000	110.430000	37.42%
5	XLV	91.260000	105.530000	15.64%
2	XLY	119.080000	137.000000	15.05%
0	XLC	50.540000	58.130000	15.02%
1	XLP	59.220000	62.700000	5.88%
7	XLB	58.010000	60.360000	4.05%
10	XLU	60.160000	60.830000	1.11%
8	XLRE	37.500000	36.260000	-3.31%
6	XLI	76.310000	71.730000	-6.00%
4	XLF	27.610000	24.030000	-12.97%
3	XLE	61.280000	36.030000	-41.20%

Once we identified the sectors with the better and worse performance, we next analyse the behaviour of these sectors index during 2020,and the performance of the top ten companies that compose them.

Energy Sector (XLE index analysis)

Given that XLE was the index that had a greater loss over the time period analyzed, we will look deeper into it and try to break down how particular industries inside this economic sector behaved.

XLE index breakdown

The XLE index portfolio is built as follows:

Industries	Weight in index
Oil & Gas Refining and Marketing	56.71%
Oil & Gas Exploration and Production	23.51%
Oil & Gas Transportation Services	9.74%
Oil Related Services and Equipment	8.59%

The top 10 stocks that constitute 77.79% of the index are:

Ticker	Company	Weight in Index

XOM	Exxon Mobil Corp	22.36%
CVX	Chevron Corp	22.13%
COP	ConocoPhillips	4.34%
EOG	EOG Resources Inc	5%
KMI	Kinder Morgan Inc	3.83%
SLB	Schlumberger Nv	4.49%
MPC	Marathon Petroleum Corp	4.11%
PSX	Phillips 66	4.21%
PXD	Pioneer Natural Resource	3.86%
VLO	Valero Energy Corp	3.46%

From our previous analysis we concluded that the energy economic sector suffered a loss of %41.00 during the time period, by analyzing the companies that constitute the index we can clearly see that the tendency continues, but it is interesting to notice that some companies like Pioneer Natural Resource (PXD) was able to soften the blow, a company that is heavily related to low-carbon energy investigation.
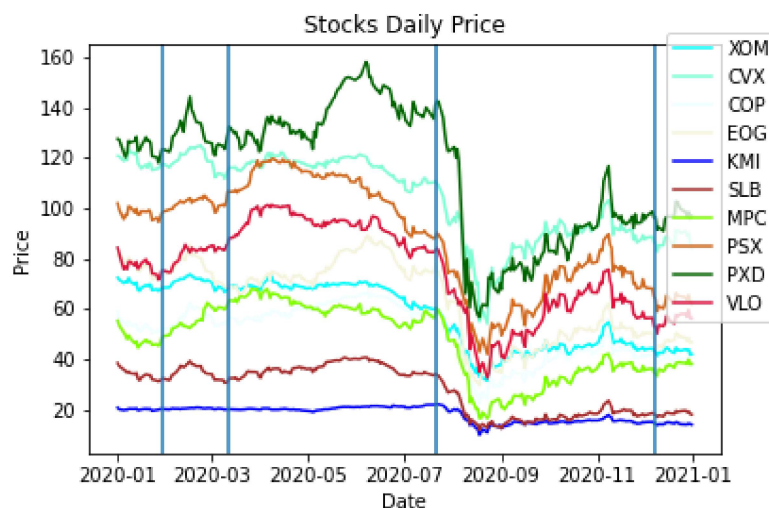
	Ticker	Initial	Final	Percentage Price Change
0	XOM	72.46	42.08	-41.93%
1	CVX	120.74	83.94	-30.48%
2	COP	58.80	37.39	-36.41%
3	EOG	81.07	46.85	-42.21%
4	KMI	20.77	14.10	-32.11%
5	SLB	38.51	18.14	-52.90%
6	MPC	55.36	38.20	-31.00%
7	PSX	101.99	62.02	-39.19%
8	PXD	127.56	96.92	-24.02%
9	VLO	84.34	56.23	-33.33%

However, if we look at the standard deviation for each stock, we can determine that most of the stocks are very volatile, assuming that this particular industry is very sensitive to worldwide phenomenons and for our particular study COVID-19 should have impacted very negatively this particular industry.

	XOM	CVX	COP	EOG	KMI	SLB	MPC	PSX	PXD	VLO
count	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000
mean	57.660632	103.828972	50.074585	63.571344	18.213597	27.887826	46.849447	88.222134	114.390791	74.610791
std	12.788134	16.561793	10.796521	15.657730	2.974914	9.204314	14.118958	21.278249	25.536021	17.758681
min	31.450000	54.220000	22.670000	29.760000	9.980000	12.050000	16.620000	42.090000	56.770000	32.620000
25%	44.320000	90.050000	41.580000	48.950000	15.120000	18.200000	36.070000	70.070000	94.110000	59.050000
50%	62.730000	111.120000	53.320000	69.800000	20.000000	32.050000	49.520000	92.640000	123.500000	77.420000
75%	69.250000	117.890000	58.880000	75.600000	20.510000	35.560000	59.840000	105.300000	133.900000	90.250000
max	73.730000	124.900000	66.480000	89.290000	22.240000	40.820000	68.020000	119.700000	158.110000	101.400000

Line graph analysis

Plotting every stock together do provide very valuable insights, as we can see the stocks had a similar behaviour pre-pandemic, as the WHO announces the pandemic the stocks present a small peak, but as quarantines start around the globe, the behaviour of the stocks are somehow erratic with a notable exception of Pioneer Natural Resources (PXD) a company that starts to separate itself from the rest of the stocks. Now, what we believe is one of the most notable phenomena is how all the stocks converge to a couple of weeks after the announcement of Phase 1 vaccines testing. Every stock apparently plummets and tries to converge to a minimum value, and after that, the stock begins to stabilize and recover

Technology Sector (XLK index analysis)

XLK index breakdown

The XLK index portfolio is built as follows:

Industries	Weight in index
Software	31.34%
Technology Hardware, Storage & Peripherals	22.77%
Semiconductors & Semiconductor Equipment	20.92%
IT Services	19.44%
Communications Equipment	3.21%
Electronic Equipment Instruments & Components	2.52%

The top 10 stocks that constitute 65.68% of the index are:

Ticker	Company	Percentage
AAPL	Apple Inc	21.48%
MSFT	Microsoft Corp	19.82%
V	Visa Inc Class A	4%
MA	Mastercard Inc Class A	3.48%
NVDA	Nvidia Corp	3.69%
PYPL	Paypal Holdings Inc	3.17%
ADBE	Adobe Inc	2.54%
INTC	Intel Corporation Corp	2.9%
CSCO	Cisco Systems Inc	2.43%

CRM	Salesforce.Com Inc	2.17%

The technology sector prices increased 37.4% from January of 2020 to January of 2021. Even though a fall of 30 points in mid-July, at the end of 2020, technology companies' prices were around 20 points higher than pre-covid levels.

	Ticker	Initial	Final	Percentage Price Change
0	AAPL	208.43	425.04	103.92%
1	MSFT	138.06	205.01	48.49%
2	V	179.17	190.40	6.27%
3	MA	274.16	308.53	12.54%
4	NVDA	164.92	424.59	157.45%
5	PYPL	110.80	196.07	76.96%
6	ADBE	298.44	444.32	48.88%
7	INTC	49.50	47.73	-3.58%
8	CSCO	55.39	47.10	-14.97%
9	CRM	150.81	194.85	29.20%

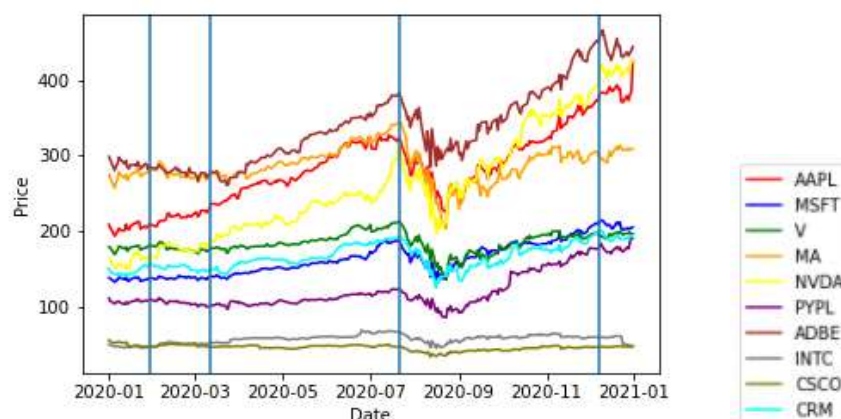|	AAPL	MSFT	V	MA	NVDA	PYPL	ADBE	INTC	CSCO	CRM
count	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000	253.000000
mean	282.662253	163.447510	183.646482	286.522095	258.581542	120.965277	336.195237	56.559526	45.671542	165.169644
std	51.932576	22.906563	13.024403	23.713864	75.419115	25.788608	52.982092	5.624821	3.565372	16.842438
min	193.340000	132.210000	135.740000	203.300000	148.770000	85.260000	261.090000	44.610000	33.200000	124.300000
25%	243.180000	140.730000	176.150000	272.190000	202.820000	104.340000	289.290000	51.820000	44.100000	152.340000
50%	279.440000	158.960000	181.790000	285.380000	245.440000	109.050000	329.640000	58.050000	46.530000	162.540000
75%	318.250000	182.830000	193.500000	301.400000	297.790000	123.660000	367.510000	59.850000	47.780000	181.060000
max	425.040000	214.320000	213.310000	344.560000	424.590000	196.070000	466.200000	68.470000	55.390000	200.740000

Line graph analysis

Plotting the data we can observe that among the official declaration of the Pandemic (second vertical line) and the announcement of the first result of the first vaccine (third vertical line) there is an exponential growth maybe because of the lockdown people started to work remotely and started to buy gadgets and pay for technology services or programs to do their daily lives, we have to get more data to prove it but this is the first steps to get the truth.

After the first announcement of the vaccines there was a drop down and after that a huge increase of the general profit this means that there is another variable not related to the virus that moved the data.

Nvidia was the greatest company to invest during 2020 it is more profitable 157.45% on percentage price change followed by Apple due to the innovation and not for a pandemic opportunity.

Plotting every stock together do provide very valuable insights, as we can see the stocks had a similar behaviour pre-pandemic, as the WHO announces the pandemic the stocks present a small peak, but as quarantines start around the globe, the behaviour of the stocks are somehow erratic with a notable exception of Pioneer Natural Resources (PXD) a company that starts to separate itself from the rest of the stocks. Now, what we believe is one of the most notable phenomena is how all the stocks converge to a couple of weeks after the announcement of Phase 1 vaccines testing. Every stock apparently plummets and tries to converge to a minimum value, and after that, the stock begins to stabilize and recover


Covid-19 and stocks performance

From our univariate analysis, we found that the energy sector prices have a negative correlation with the cumulative worldwide cases of COVID-19, when cumulative cases increased the prices of the energy sector decreased. However, as we have seen in the sector analysis, the energy sector index fall did not start at the beginning of the pandemic, but after mid-July. For the energy sector, the cumulative cases explained 26% of the variation of this sector stock prices.
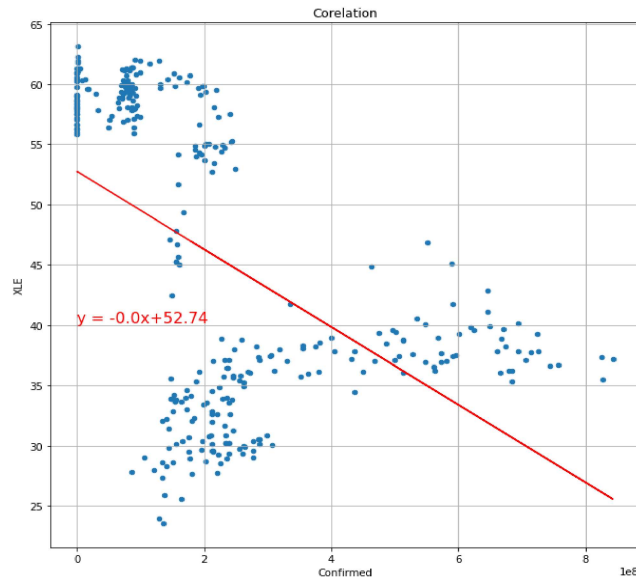
On the contrary, the technology sector prices have a positive correlation with the cumulative worldwide cases of COVID-19, when cumulative cases increased the prices of the technology sector increased. However, this correlation is not linear, as we have seen in the sector analysis, the technology sector index fell down during mid-July. For the technology sector, the cumulative cases explained 31% of the variation of this sector stock prices.
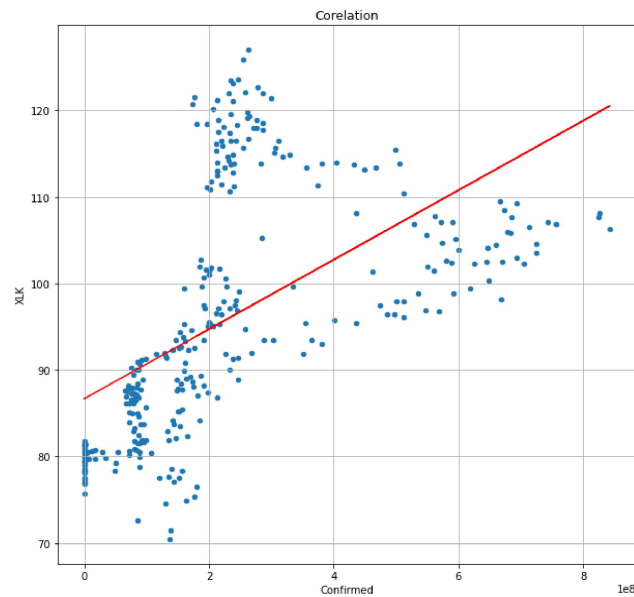
Our analysis provided simple insights of the performance of the stock markets and COVID-19 cases, nonetheless we are aware that there are a large number of variables that affect the stock markets not just the pandemic, examples of these variables during the analyzed period are:

- Innovation in technology
- External Trade
- Government policies

- Oil prices
- Supply and Demand
- Supply chains
- The political situation

References

- XLE (2021,05,05). In ETF. https://www.etf.com/XLE#overview
- What Are the Sectors and Industries of the S&P 500? (2021,05,05). In the balance. https://www.thebalance.com/what-are-the-sectors-and-industries-of-the-sandp-500-3957507
- spdr-etf-listing.pdf (2021-05-05). In State Street Global Advisors SPDR. https://www.ssga.com/library-content/products/fund-docs/etfs/us/information-schedules/spdr-etf-listing.pdf
- Companies Tickers. https://stockmarketmba.com/stocksinthesp500.php
- Covid-19 cases https://www.kaggle.com/jcsantiago/covid19-by-country-with-government-response?select=covid19_by_country.csv
- Daily stocks 2020. https://www.alphavantage.co/