Impact of Covid-19 on the US Stock Market by Phases and Sectors

Research questions

Since Covid-19 erupted, stock markets were severely affected. We studied the representative S&P 500 index in **3 phases: (1) crash (2) recovery and (3) stable** identified according to the pandemic timeline. We aim to analyze how the Covid-19 changed the investment favor of investors based on the following dimensions:

1. The linearity between stock market and Covid-19.
2. How did the Covid-19 change the investment proportion in **different sectors** and in the **3 phases**? By comparing the US stock market **before and after the pandemic**.
3. What sectors and firms are most **affected** or **defensive** during the Covid-19?
4. What can we find by comparing the **correlation among sectors**?

Dataset introduction

The covid dataset extracted from https://covid.ourworldindata.org/data/owid-covid-data.csv includes 160237 observations which shows worldwide Covid-19 cases starting from 24/2/2020 to the latest. The SP500 index from the R package "tidyquant" contained 517 observations showing the price, trade volume and sectors.

Methodology

Firstly, the world map portrays a general picture of the worldwide total Covid-19 cases with the cases shown by the color density and death rate demonstrated in bubbles.

Secondly, linear regression can show the linearity between X (i.e. Covid-19 cases) and Y (i.e. SP500 index)by studying the coefficient and significance level of X towards Y. This regression can establish a fundament for our following investigation which focuses on sectors and three phrases during pandemic.

Thirdly, line graphs and the bump chart show the changing investment pattern by comparing the market capital of 11 sectors over periods. The graphs highlight the investment patterns in the 3 specific phases by identifying (1) the ranking of the 11 sectors, (2) steepness of the line slopes which show the percentage change of market capital. The dropping and recovering rate can identify the volatility of the 11 sectors. Moreover, the gif bar graph clearly demonstrates the investment trend in sectors during the pandemic.

Additionally, the tree map shows the market capital of each sector via area size and the percentage change of firms indicated by color. Then, we can know what firms or sectors worth investing in the 3 specific phases.

Finally, the correlation graph explores the relationship among sectors and the changing patterns discovered can be utilized for constructing a real-life investment strategy such as hedging strategy for risk reduction purposes in long term investment perspective.
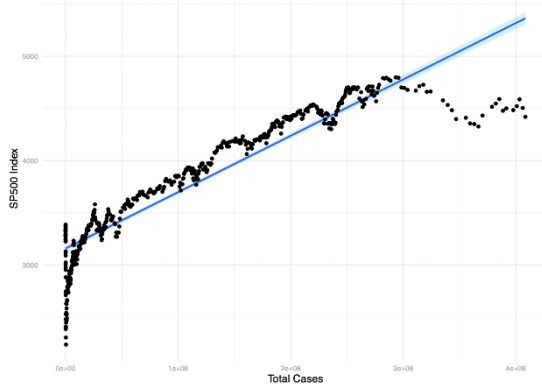
Results
World map showing general picture of the Covid-19

Covid-19 is a worldwide pandemic. The color density represents the severeness of cases with darkest blue marks the highest and red dots indicate total death cases, the number is represented by the circle size.

(1) Linearity between Covid-19 and SP500 index

In overall, the cumulative cases of Covid-19 and the SP500 index (from Feb 2020 to the latest) are positively correlated. The result is significant as shown below.
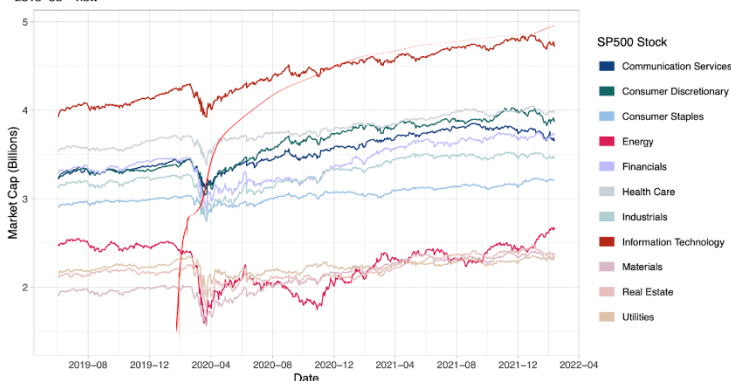
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Calls:
m1: lm(formula = close ~ total_cases, data = data1)

============================================
  (Intercept)    3157.846***
                   (15.818)
  total_cases       0.000***
                    (0.000)
--------------------------------------------
  R-squared         0.851
  N                 521
============================================
Significance:
               *** = p < 0.001;
               ** = p < 0.01;
               * = p < 0.05
```

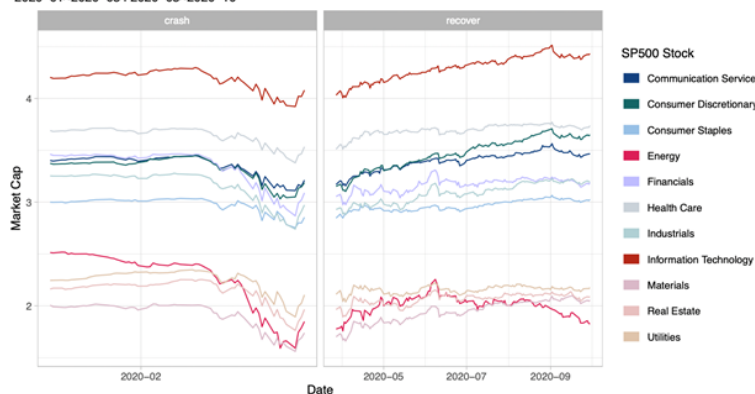## (2) By phases and sectors investigations through line graphs and bump chart

We identified 3 key phrases in terms of the line graph showing the market situation. The pre-pandemic data archived between Jun 2019 - Dec 2019.

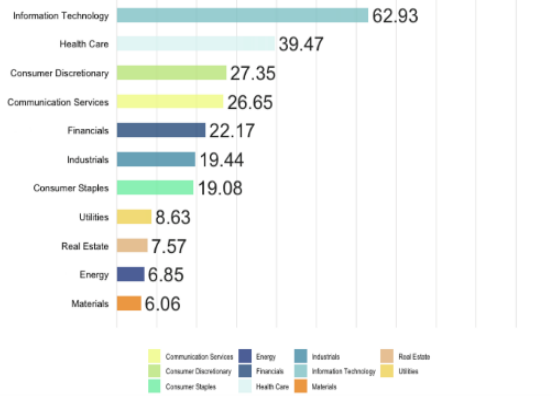| 1st Phase (Crash)	Jan 2020 - Mar 2020
2nd Phase (Recovery)	Mar 2020 - Sep 2020
3rd Phase (Stable)	Mar 2021 - Sep 2021

The 11 sectors can be divided into 3 tiers (High, Middle, low) according to the market capitalization size. The 3 distinctive color groups differentiate among them.

From the crash phase, all the sectors dropped sharply due to the black swan incident, among them the energy sector drop is the steepest.

For the recovery phase, sectors took around a half year to recover.

Gif line graph

SP500 Market Cap During Covid-19 Pandemic in Billions, Sum by Sector
Time Period: Jan.2020~Oct.2020, Daily Frequency
2020-04-20

| Sector	Value
Information Technology	62.93
Health Care	39.47
Consumer Discretionary	27.35
Communication Services	26.65
Financials	22.17
Industrials	19.44
Consumer Staples	19.08
Utilities	8.63
Real Estate	7.57
Energy	6.85
Materials	6.06

The market cap of IT, consumer discretionary (CD) and communication services (CS) even exceeded the pre-Covid period. Also, they experienced the fastest recovery speed among all. Utilities and health care sectors also performed well in their tiers, which they recovered to their original market cap.

The gif shows IT and health case always staying the 1st and 2nd. The ranking merely change position.

However, other sectors change their position with the crash period and gradually change to the stable position in the recovery period. Click here for gif

Trends of Market Cap in Sections: Pre–covid vs. Stable Period
Before 2020–01 | 2021–03~2021–10
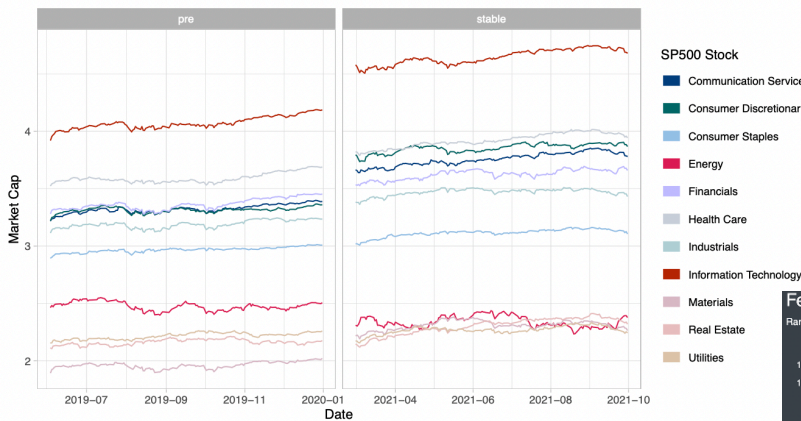
By comparing the pre and stable phases, many sectors keep growing, except for energy, utilities, and real estates. Among these, CD, IT and CS are growing to the largest extent.


Energy, **Materials**, **Real Estate and Utilities** are the most **fluctuated** sectors, however since the pandemic turning normalized, energy and materials returned back to their pre-pandemic state.

Besides, IT always rank 1st among the 3 phases, so it is the most favorable sector. CD and Financial swapped positions, real estate and utilities changed positions as the former sector (CD, real estate) is more favorable than latter one (Financial, utilities) for investors.

(3) Tree Map showing details by companies

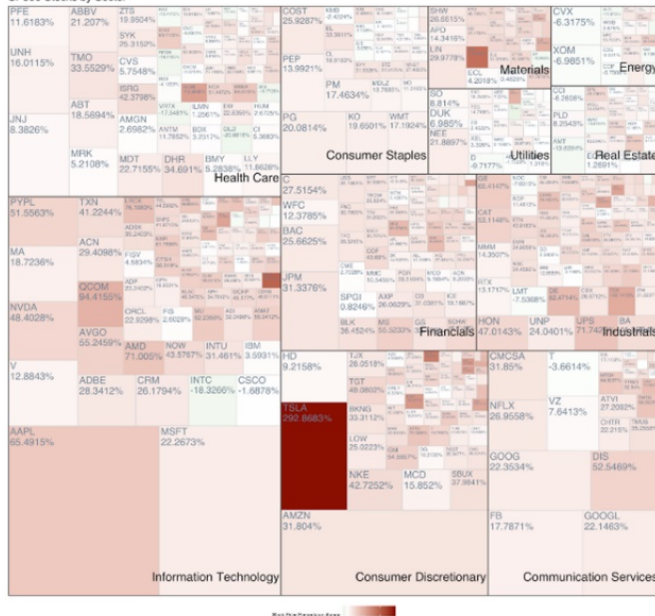Market Cap and Percentage Change(Period: Stock Crash)
SP500 Stocks by Sector
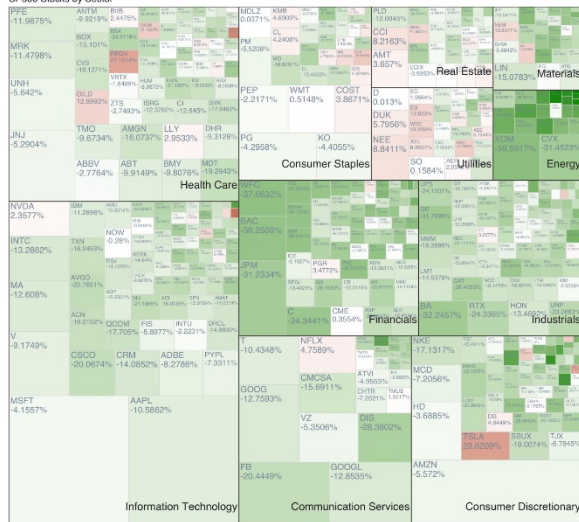
During the crash phase, the severely affected sectors are energy, financial and industrials as indicated by the color density. However, the stocks Tesla and REGN even gained a large market cap, which are 29.6% and 27.2% respectively. Comparing the pre-Covid and Post-Covid stable periods, many stocks in pre-Covid are growing. Color for TSLA is darkest as it sharply outperformed others and gained nearly 300% increase in market cap. The divergence of TSLA results in the overall tree map color lighter.

The color for the stable phase is obviously darker than the pre-Covid, the percentage change extent is more concentrated

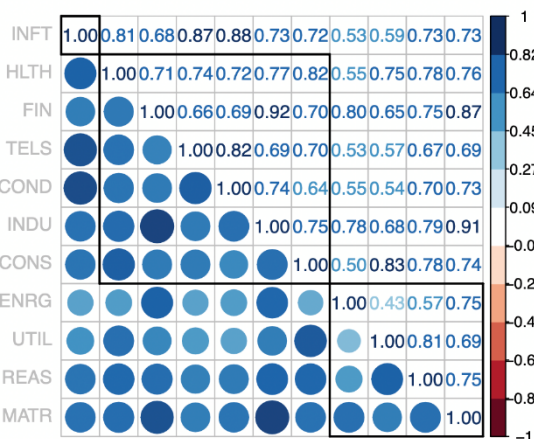Market Cap and Percentage Change(Period: Pre-Covid)
SP500 Stocks by Sector

Market Cap and Percentage Change(Period: Stable)
SP500 Stocks by Sector
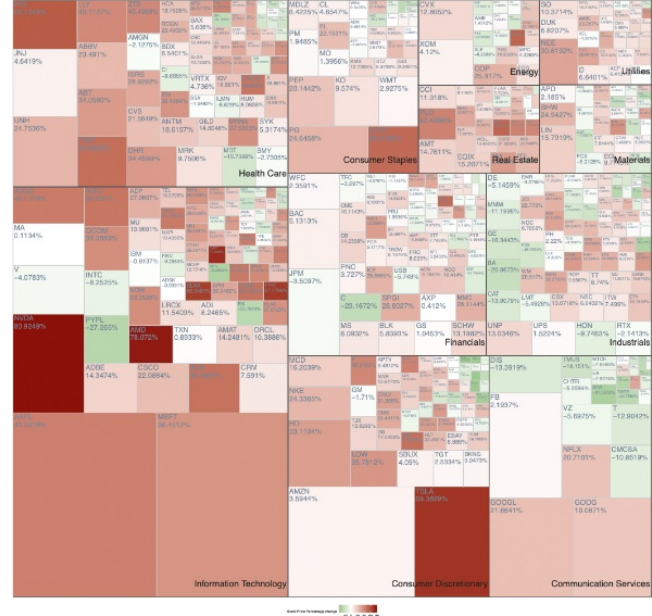
as there is no outlier. NVDA gained the largest increase (80.9%), TSLA (69.4%) and AMD (78%) also gained a relatively large increase.

(4) Correlation among sectors for hedging purpose

Correlation Between Sectors

The correlation among sectors are highly correlated, ranging from the highest 0.92 to the lowest 0.43. To implement hedging strategies, investors may better invest sectors with a low correlation which can help them to reduce risk in some unstable period or unexpected shocks. For example, the correlation between UTIL & ENRG is relatively low (0.43).

Conclusion

In general, SP500 Index is associated with the Covid outbreak and sectors are highly correlated with each other. The Covid only caused a short-term downturn for the stocks. The whole market gradually returned to the original in long term without much divergence compared with the pre-pandemic period.

Among sectors, IT is worthy to invest in even in the tough time, however energy, materials, real estate and utilities sectors have large fluctuation among 11 sectors. Besides, TSLA has a strong market growth rate in time among the companies.

Reference

- Market Phases Led by COVID Trends: What Do They Tell Us? (24 Sep 2021), HKTDC Research. Retrieved from https://research.hktdc.com/en/article/ODYxNDg2MjM4
- Mathieu, E., Ritchie, H., Ortiz-Ospina, E. et al. A global database of COVID-19 vaccinations. Nat Hum Behav (2021)   https://ourworldindata.org/covid-vaccinations