

# Financial Market Performance and Sector Analysis Pre, During, and Post Covid

W200 - Project 2

Amir Moazami, Svein Gonzalez, Kai Ding

Github Repository: [https://github.com/UC-Berkeley-I-School/Project2\\_Moazami\\_Gonzalez\\_Ding](https://github.com/UC-Berkeley-I-School/Project2_Moazami_Gonzalez_Ding)

Primary datasets: Yahoo Stock API, [Kaggle](#)

## Introduction

With the most recent news of a looming recession, we thought it'd be interesting to explore the market's behavior and idiosyncrasies in the last 10 years. We broke up our analysis into three phases: Pre-Covid, During-Covid, and Post-Covid. We built our foundation from a Kaggle S&P500 dataset that updates daily to include most recent financial data. Then, we paired the dataset with the Yahoo Finance API to fill in missing data, such as sector, industry, and MarketCap. Since our dataset went as far back as 2010, at times during our exploration we had 950,000+ observations.

We wanted to explore:

- 1) A comparison of leading companies' stock performance to that of the whole market and seeing if the correlation is a trustworthy indicator of market performance for the Nasdaq, DowJones, and SP500.
- 2) Sector performance and leading players
  - a) Analysis of the power that leading players have in their sector
    - i) How much is each sector concentrated or segregated?
    - ii) Are there any important market trends across sectors pre, during, or post COVID?
    - iii) Does normalizing by relevant metrics (market size) reveal any interesting insights?
  - b) Which industries have performed best since Covid-19? And what impact do major players have on this industry?
- 3) Which industries were thriving throughout the pandemic?

## Sanity Checking & Assumptions

Before we started any analysis, we explored the data to assess its integrity. In our exploration, we identified that certain variables of interest were missing: Industry, Sector, Shares, and Market Cap. However, we were able to utilize the Yahoo Finance API to access companies' financial profiles and retrieve the information of interest. Then we filtered by symbol to apply the newfound information. After filtering and applying, our data didn't contain any null values because we only received financial data on days the stock market was open.

## Section #1 - Industries and Market Performance

First, we had a basic hypothesis that the financial world is changing due to COVID and that corporations that were previously driving the overall financial market are no longer the primary indicators of the entire market. As a result, we are experiencing a paradigm change in the whole financial system, and the market will never return to how it was operating before the COVID period. We began by setting up our research to assess the market across three distinct time periods. We allocated a timeframe for analysis prior to the COVID period, which will run from 2015 to 2019 (a total of 5 years). Then, for the COVID era, we set the time line from 2019 to 2021 (a total of two years), and for the post-Covid period, we set the time line for one year from mid-2021 up to the present (a total of one year).

However, we wanted to observe the impacts in a broader schema of effects, so we chose the top three businesses from the sample industries to examine the influence and correlation of each of them on the whole market.

Thus, we started our research by analyzing the top three corporations in each of our three sample industries, which we considered the most controversial. As a result, we picked three businesses from the Tech sector, the auto manufacturing industry, and the energy industry. Which their names are as follows:

- **Tech Industry Leaders:** Apple, Microsoft, Nvidia
- **Energy Industry:** Chevron, Exxon, Valero
- **Automotive Industry:** Ford, Tesla, General Motors

Please check out Appendix.1 for further information on how we obtained and cleaned this data.

We assessed the return value for each of the industry leaders for our three separate periods. As a consequence, we obtained the daily actual monetary value difference for each company and recorded the results in another dataframe for each period. After this looked at the relationships between each of these businesses compared with the overall performance of the S&P 500 market to determine whether or not these businesses are related to the overall performance of the market and how much influence they have on the market as a whole. Consequently, we created a heatmap of correlation for these organizations across three distinct times ( Pre-Covid, During-Covid and PostCovid).

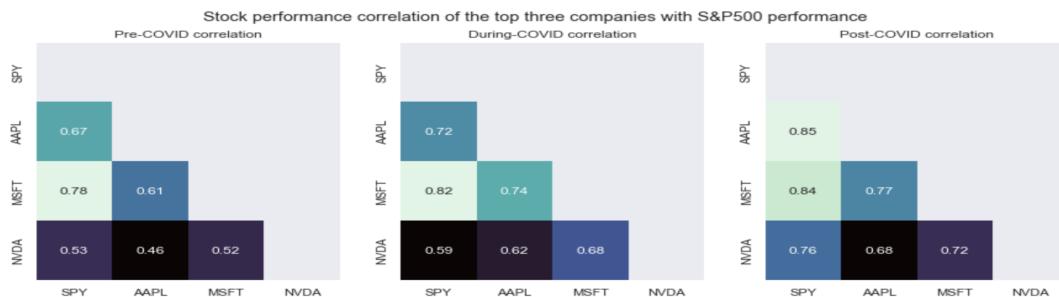


Fig.1  
Top 3 Tech  
companies VS  
SP500

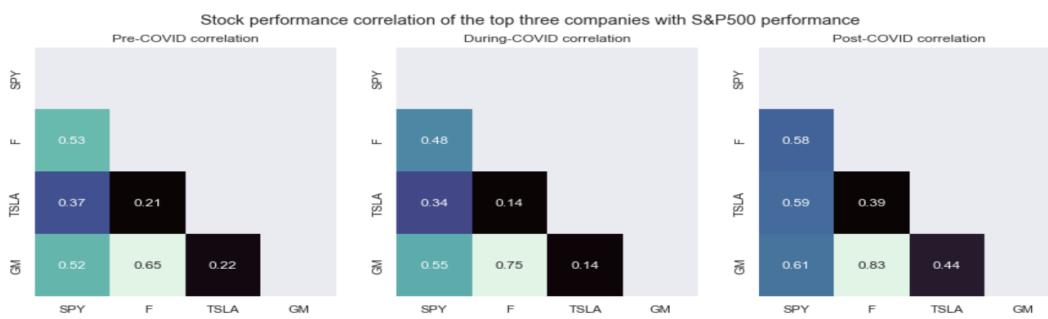


Fig.2  
Top 3 Automotive  
companies VS  
SP500

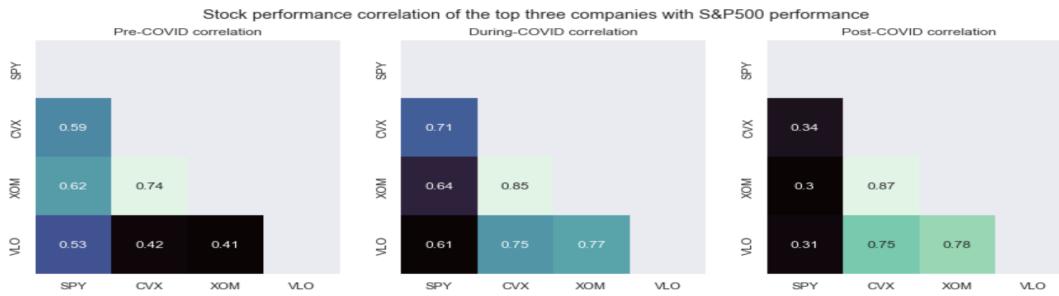


Fig.3  
Top 3 Energy  
companies VS  
SP500

The chart demonstrates each company's performance compared to the performance of the S&P 500 market as a whole. The top tech companies' relevance to the overall S&P 500 market is increasing, and it appears that this has happened over the period that we have been observing. Prior to the COVID period, these companies weren't as relevant. However, during the COVID period, they became very relevant, and following

the COVID period, their relevance to the overall market performance has continued to grow. In addition, we have observed that NVIDIA, which was not particularly closely relevant to the S&P 500, is now becoming one of the leaders.

Contrarily, we observed that the top three energy companies had moderate ties to the S&P 500, which had been growing during the COVID period and for post COVID, however, they began to lose their ties to the overall market. This could be due to a variety of factors, but the overall inference we can draw is that the top three energy companies are no longer closely tied to the performance of the market as a whole.

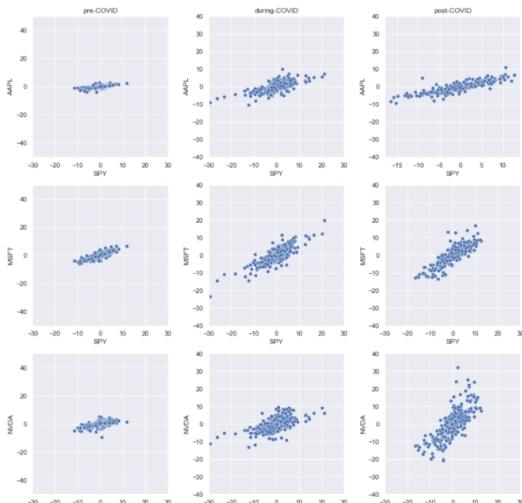
In addition, the relevance of the automobile industry almost remained constant during the whole period, with the exception of Tesla Motors, which may be associated somewhat with the technology sector and increased its relevance significantly over the course of our study.

In order to draw more precise conclusions from the facts we had, we began plotting the volatility of each company in each industry for timeframes of before, during, and after the COVID period in a ScatterPlot and analyzing their relevance in different and further detail:

Fig.4.top three industry companies' comparison to the S&P 500

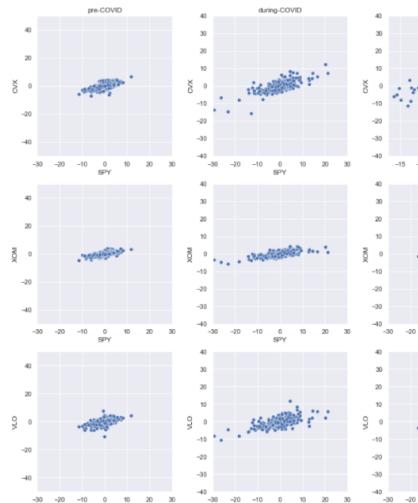
### Tech Sector:

(Apple, Microsoft, Nvidia)



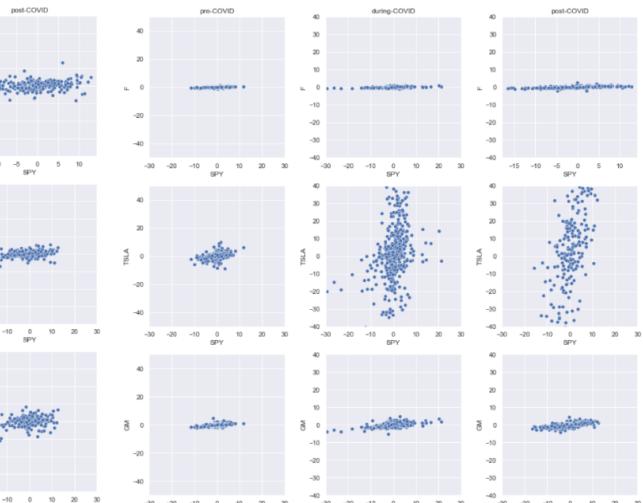
### Energy Sector:

(Chevron, Exxon, Valero)



### Automotive Sector:

(Ford, Tesla, GM)



Please check out Appendix.2, 3, and 4 for more zoomed in graphics for each of the graphs seen above.

One of the most crucial things to keep in mind when interpreting these volatility diagrams for individual firms in various sectors is that: the more closely the S&P 500 is tied to these businesses, the more the graph will be aligned to the  $x=y$  hypothetical line for each scatter plot. Meaning that the amount of return change for the SP500 at that point in time is equal to the amount of return change in the stock we are analyzing, and when the trend remains in the same format, we can see the scatter plot dots will align more closely with the 45 degree hypothetical line, and when they diverge from this 45 degree line, the correlation is less substantial. In Figure 4 (Appendix.2), for example, we can observe that the volatility graph almost produces a 45 degree angle line in our scatter plot during the post COVID era, indicating substantial correlation between these two variables. If we see a vertical line, it implies that the firm we are investigating is in fact more volatile than the performance of the S&P 500 market. Also If we see a horizontal line, it suggests that the company we are

analyzing is more stable than the overall market. Additionally, if all the data is in the middle, it indicates that the overall financial market and that company have a solid correlation.

In our case, we continue to see that the IT sector is becoming more relevant to the whole market over time, while the energy sector is losing its correlation to the overall market. The automotive industry (with the exception of Tesla) has remained nearly unchanged.

In our post - analytical part for this question, we explored Nasdaq, DowJones, and SP500 financial indicators during the three periods of before COVID, during COVID, and after COVID because we wanted to know how the overall market performance is in various periods of time with different market indicators.

Fig.5 Market Indicators for Pre COVID period



Fig.6 Market Indicators for During COVID period

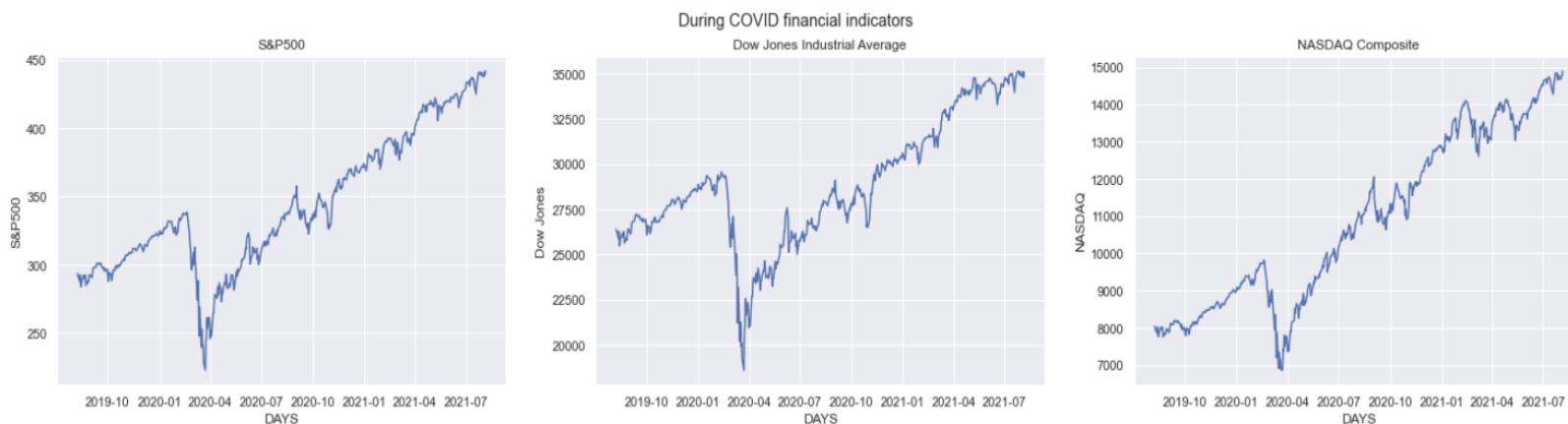
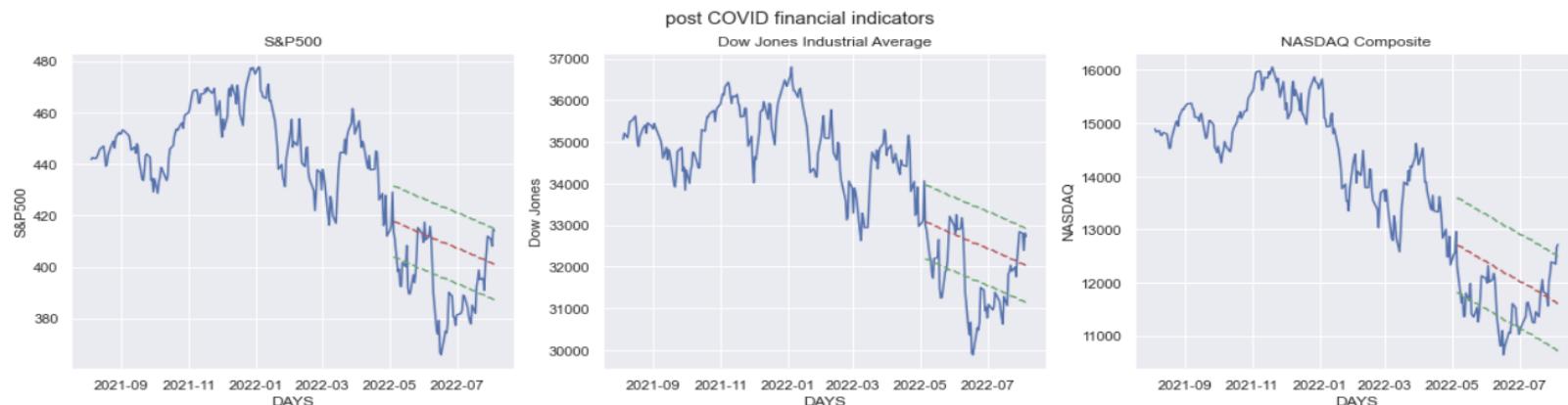


Fig.7 Market Indicators for Post COVID period



With the exception of a small financial downturn in 2018 (unrelated to COVID), we may draw several interesting insights from evaluating these charts alone. The market was overall growing at a positive rate before the COVID period. Also, during COVID, there was a severe decline in the financial market, with the major one around March of 2020, which rebounded to its prior level immediately after COVID in a total of 6 months (around October of 2020) and continued its rise as it had before COVID. However, from last year to now, we have seen a continued fall in the overall market, with three of our three indicators indicating that the country's recession is occurring right now after the COVID period, despite the fact that many people believe that COVID was the primary cause of the recession.

## Section #2 - Sector Performance & Leading Players

Next, we deep-dived into one of the indices, S&P 500, to analyze sectors. Specifically, we will: 1) Analyze how much influence the Top 3 players have on their sector performance 2) Identify historical market trends, and study the impact of Covid

### Important callout

Sector is strictly based on S&P 500, and may not be the same as our intuition. For example, in S&P 500, Tesla and Amazon are in Consumer Cyclical, and Google is in Communications, rather than Technology

### Sector concentration: What does sector concentration look like in S&P 500?

We start by reviewing the current sector concentration within S&P 500. We define concentration as:

- Top 3 companies market cap / sector total market cap
- In a highly concentrated sector, top companies would have a lot of market share, and therefore a lot of power over the entire sector - we might even describe them as monopolies

The following chart ranks sectors from the least concentrated to the most concentrated. The top concentrated sectors are Technology, Energy, and Consumer Cyclical, with leading players having ~40-60% of the sector total market share.

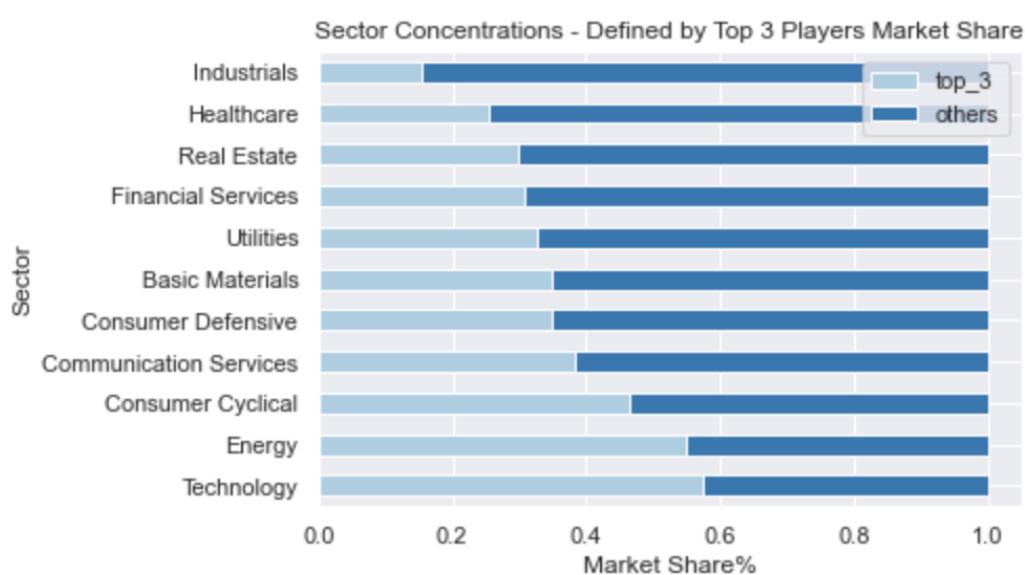


Fig.8.

## Outliers: How far ahead are the leading companies in their sector?

Some hypotheses we tried to verify include:

- How far ahead are the leading companies in their sector? Are they very similar in market size with their peer group, and or are they much ahead of the competition?

To verify, we plot the range of market cap by sector. In the chart, bar represents the difference between the largest and the smallest company in the sector. From the plot, we can see that: In Tech and Consumer Cyclical, differences between largest and smallest companies are most significant, especially in Tech, where the difference is in trillions of dollars. Energy ranks #6 in the middle, so the leading company leads by a smaller margin, compared with Tech and Consumer Cyclical

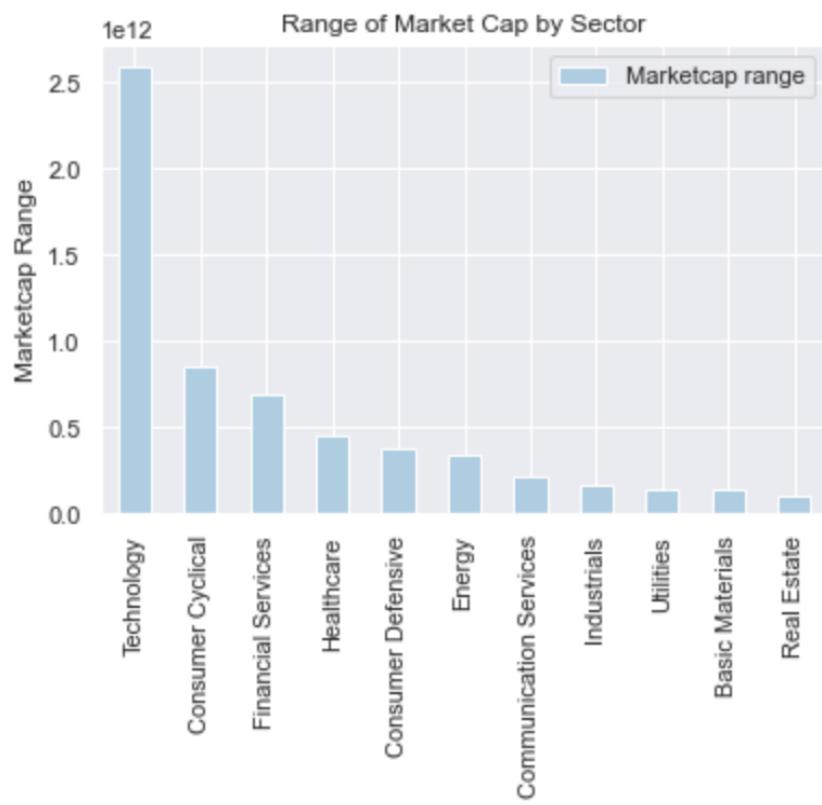


Fig.9.

## Historical Trend & Covid: What is the historical trend of sector concentration? How did Covid impact the trend?

We further dive into historical trends of sector concentration. In this section, we picked the Top (Technology) and Bottom (Industrials) most concentrated sectors. Some hypotheses we studied include:

- How have the sector concentrations changed over time? For example, has Tech always been so concentrated, or is this a more recent situation?
- What is the role of Covid in changing the historical trend?

We did two types of analyze to answer these questions: 1) Historical trend: We studied the sector concentration trend from 2009 to 2022. 2) Rate of change: We grouped time series data on quarterly basis, and studied the rate of change from quarter to quarter

Our key takeaway is that Covid played the role of trend accelerator, meaning Covid amplified the existing market trend that was already happening in the sectors even before Covid. If a sector was rising in concentration, it rose even faster after Covid; if the sector was declining in concentration, it declined faster. As examples:

- Tech was rising in sector concentration since 2016. Around the dotted line (Covid date), the trend was accelerating - on the right-hand-side chart, we confirmed that the tallest bar represents Covid (2020 Q1). Tech was increasing in concentration for most of the quarters pre-Covid, but the speed of increase immediately after Covid was faster than ever before
- Industrials was declining in concentration, and a very sharp decline immediately post-Covid was confirmed by the right chart, where the steepest drops happened in Q1-Q2 2020.

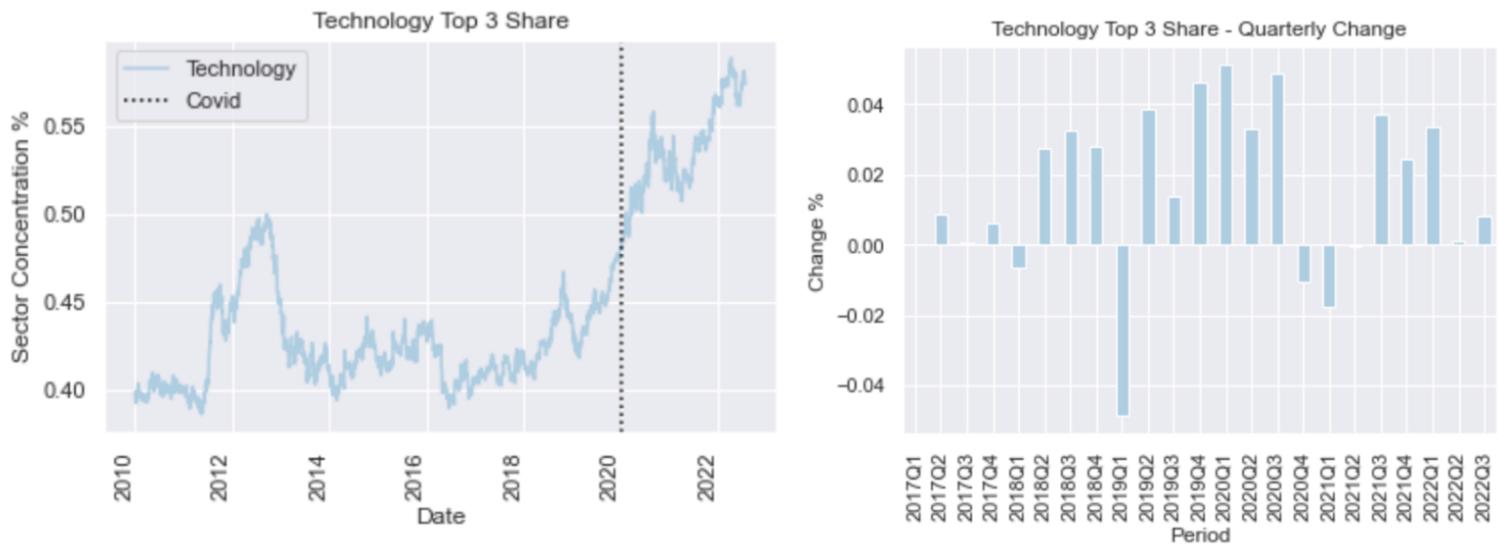


Fig.10.

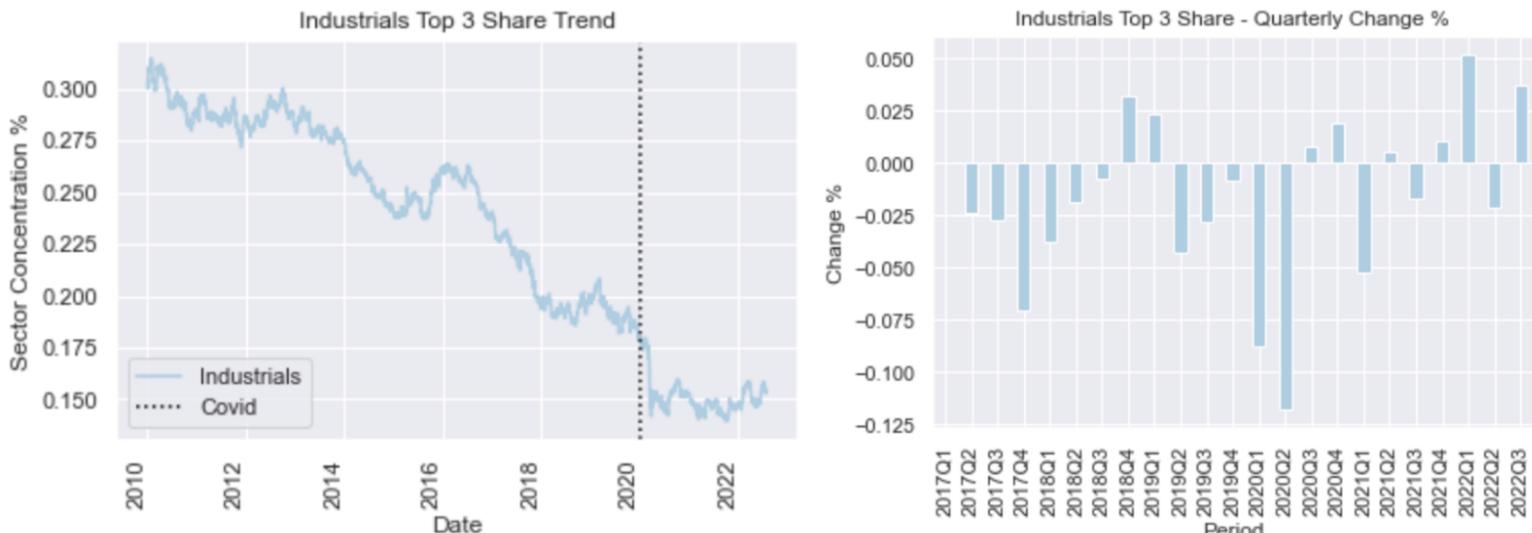


Fig.11.

## Rise and fall of big companies: How did current top players rank historically?

We further study the rise and fall of big companies within their sectors, we picked the Top 5 companies in Tech and Industrials, and studied their historical rankings. Hypothesis include:

- How consistent are the top players - are they winning consistently in the past, or do they rise to the top more recently?
- What are the differences in sector dynamics between Tech and Industrials?

We discovered the following:

- Technology: Apple and Microsoft are the clear Top 2, although they switched their positions around 2019, with Apple becoming #1 and Microsoft as #2. In this sector, changes could happen fast. For example, NVIDIA ranked outside of top 25 in 2015 but became #3 in 2020 in just 5 years. Broadcom also rose from outside of top 25 in 2010 to be #4 in 2022
- Industrials: Compared with Tech, the Top 5 are more stable. Most Top 5 companies ranked within Top 10 historically. This sector had much fewer disruptions from new-comers - the changes in ranking were also much more gradual - there's no dramatic rise

- **Deepdive Technology: Which industries within Tech are driving the trend?**

Tech looks like a really interesting sector that is prone to disruptions. We further deep-dive into Tech too analyze what industries are driving the trend, by performing 2 analysis: 1) We calculated industry share % of the total Tech sector. 2) We plotted industry total market cap trend

Our key insights include:

- (From top chart) Significant increases in total market cap happened in Software, Consumer Electronics, and Semiconductor. The market correction happened in 2022, where overall Tech dipped, but these 3 remain the largest industries in Tech
- (From bottom chart) In terms of share in Tech, Software and Consumer Electronics are gaining share, meaning they increase faster than Tech average. Semiconductor remained stable, meaning it's moving roughly in-sync with overall Tech
  - Consumer Electronics was mainly driven by Apple Inc. performance
  - "Software is eating the world" may be an exaggeration, but it is eating up the Tech sector



Fig.12.

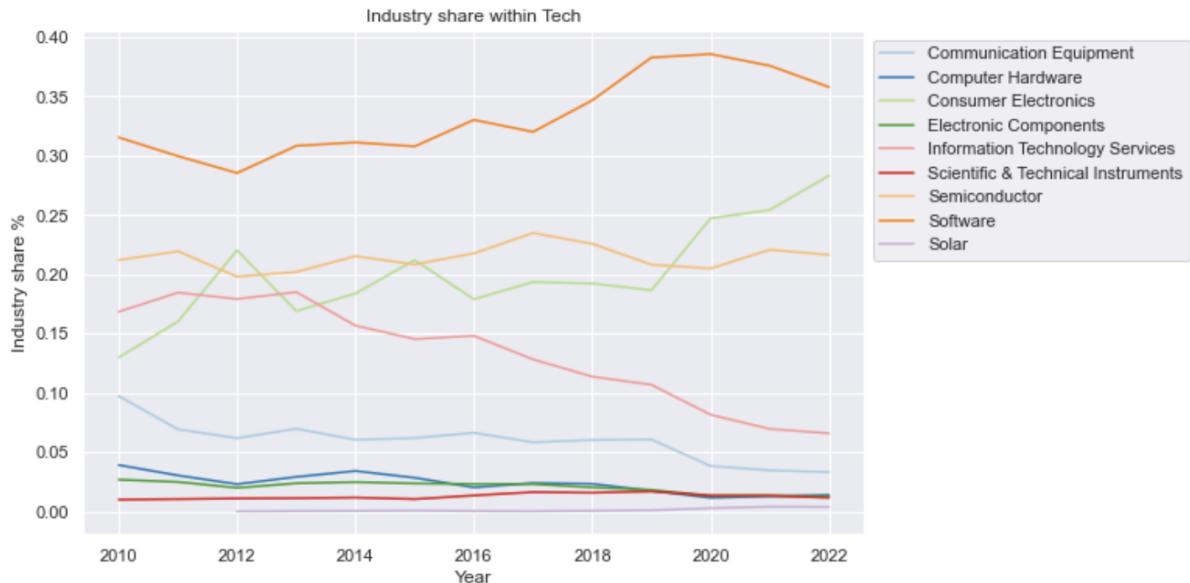


Fig.13.

## Summary for section 2

- We start by looking at sector concentration in S&P 500, and identify the Top 3 most concentrated sectors as Technology, Energy, and Consumer Cyclical.
- All 3 sectors have outliers - huge top companies that are much bigger in market cap than their peers. Particularly in Tech, the gap is much more dramatic than any other sector
- We then looked at historical trends, and discovered that Tech was becoming more and more concentrated in top players from 2009-22, approaching/surpassing the level in Energy, a sector that's historically considered monopolistic. Contrary to intuition, Covid did not change the trend, but accelerated it - Tech was becoming more concentrated even faster than before
- Next we looked at top players within Tech. While top 2 companies (Apple and Microsoft) are stable, the sector is prone to disruptions from new players - an upstart can become a Top 5 company in as little as 5 years - never happened in a traditional sector such as Industrials
- In terms of industry, Software is eating up Tech sector, while Consumer Electronics was driven by Apple and Semiconductor remained stable

## Section #3 - Thriving Industries Inside Sectors

### Research Question: Which industries were thriving throughout the pandemic?

Now, we'll take our investigation one further level. After looking at sector performance, we thought it'd be interesting to identify the industries within the sectors that benefited the most from COVID-19. So, how did sectors react to the pandemic?

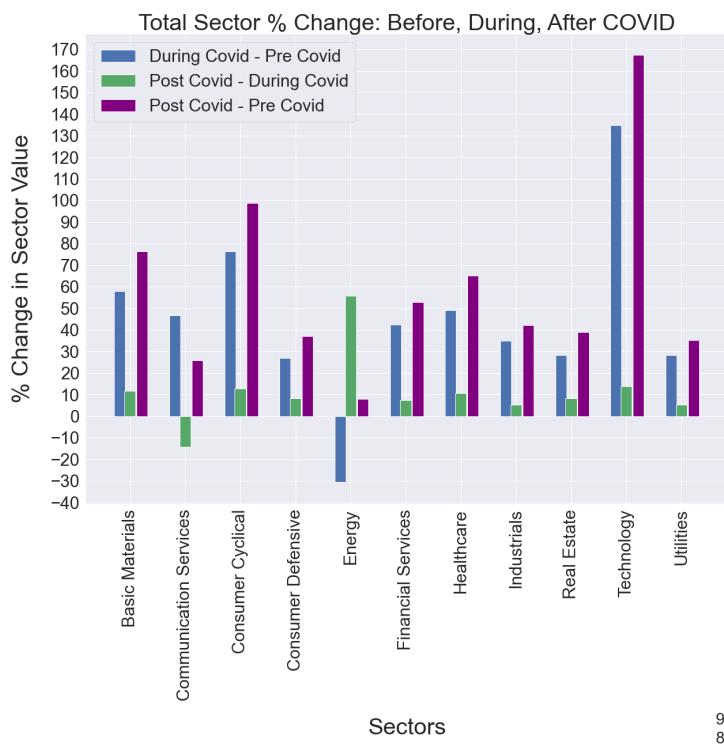


Fig.15.

First, we thought it'd be helpful to present how sector values changed by phases: Pre, During, and Post COVID. We analyzed the transitions of Pre-Covid to During Covid, "During Covid - Pre Covid", and During-Covid to Post Covid, "Post Covid - During Covid". As previously stated, the market continued to grow despite the Pandemic. Most notably, sectors like Technology and Consumer Cyclical, experienced the biggest positive change in sector Value. Meanwhile, Energy was the only sector that was impacted negatively by the Pandemic

"Post-Covid - Pre-Covid" shows overarching change over our time of interest. But what was the change in sector strength relative to the market?

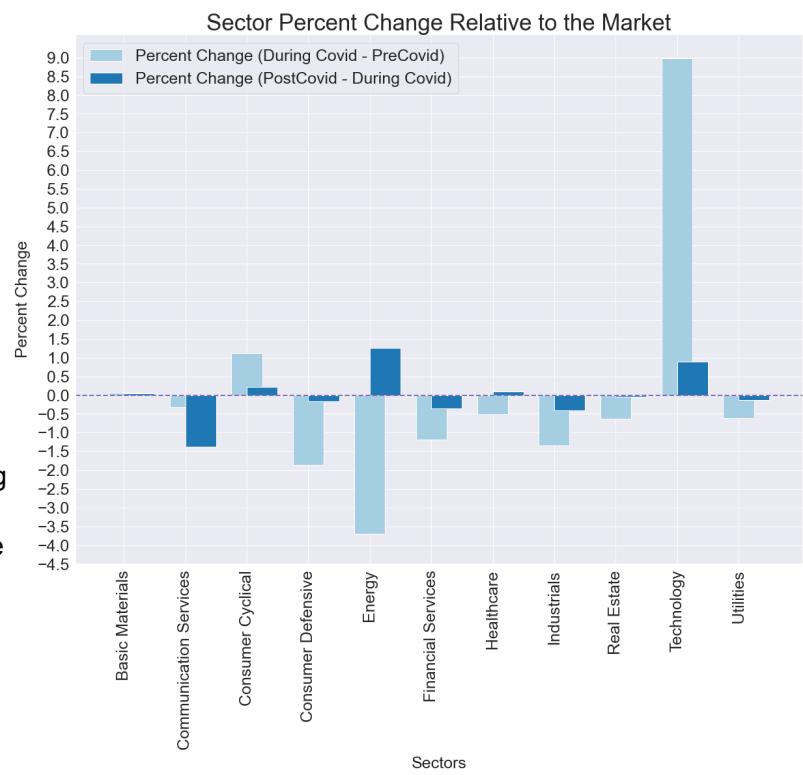


Fig.16.

To measure each sector's strength (sector value/ S&P 500 value) we had to comb through our data and group by Sector. Then, we measured the differences between During Covid and Pre Covid. Our analysis revealed that Technology and Consumer Cyclical were one of the few sectors that gained noticeable strength relative to the market. Meanwhile, other sectors such as Energy, Consumer Defensive, Industrials, and Financial Services lost some positioning relative to the market.

Interestingly, sectors seemed to have stabilized

in a Post-Covid vs During-Covid analysis. This means that for the time being sectors have remained steady in their relative positioning.

We postulate that technology was driven by electronics and remote work support which would have seen huge demand during the pandemic. Consumer cyclical could be explained by the invigoration of online shopping. To find the industries that thrived the most during the Pandemic, we'll dive deeper into the sectors that benefited the most from COVID, Technology and Consumer Cyclical.

Fig.17.

Sector	% Relative Difference: During vs Before	% Relative Difference: After vs During
Basic Materials	0.056601	0.037231
Communication Services	-0.319409	-1.380495
Consumer Cyclical	1.109149	0.214076
Consumer Defensive	-1.853618	-0.156855
Energy	-3.701187	1.255840
Financial Services	-1.182609	-0.358701
Healthcare	-0.513114	0.087787
Industrials	-1.349089	-0.403634
Real Estate	-0.623835	-0.049603
Technology	8.984657	0.885354
Utilities	-0.607546	-0.131000

## Technology Sector Analysis

Below, Fig.18., is the breakdown of industries inside the Technology sector. Overall, there are 72 companies listed in the S&P 500 that fell under the Technology Sector. Inside the sector, the industry with the most companies was Semiconductors. Meanwhile, Consumer Electronics had the least reported participation with just one company listing under it. Next, we'll inspect the commanding percentage of each industry inside the sector and how it changed during the Pandemic.

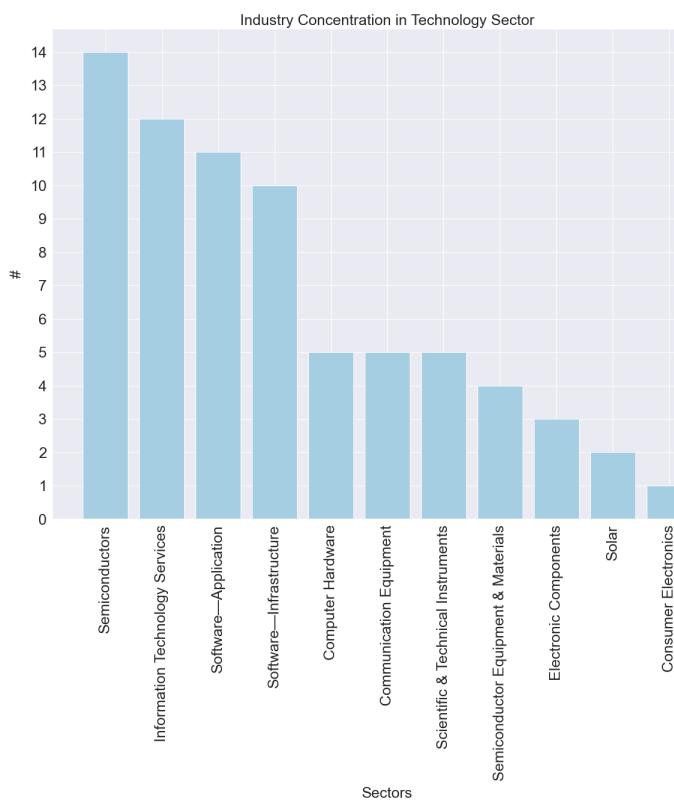


Fig. 18

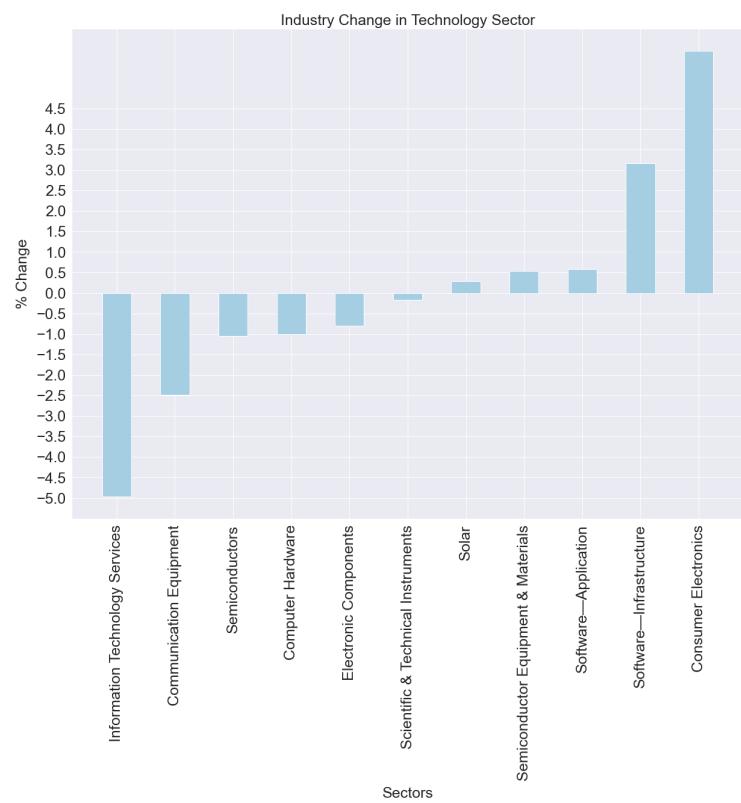


Fig.19.

Next, our analysis, Fig. 19., showed that Consumer Electronics grew the most During Covid. Apple is the sole company inside that industry. Well, it's no surprise that Apple saw a huge uptick during the Pandemic. More people were stuck at home which meant buying/ upgrading computers and shopping for Apple peripherals was more feasible with the extra cash people had from not spending. Also, companies had to invest more in remote work capabilities which meant getting more laptops for employees.

The next two industries, Software Infrastructure and Software applications, also support the idea of remote work transition.

### Consumer Cyclical Sector Analysis

Compared to the Technology Sector with a range of 13, the Consumer Cyclical Sector is more fairly distributed with a range of 7. Specialty Retail reigns dominant with a total of 8 companies, while there are several "niche" industries with only one company listed.

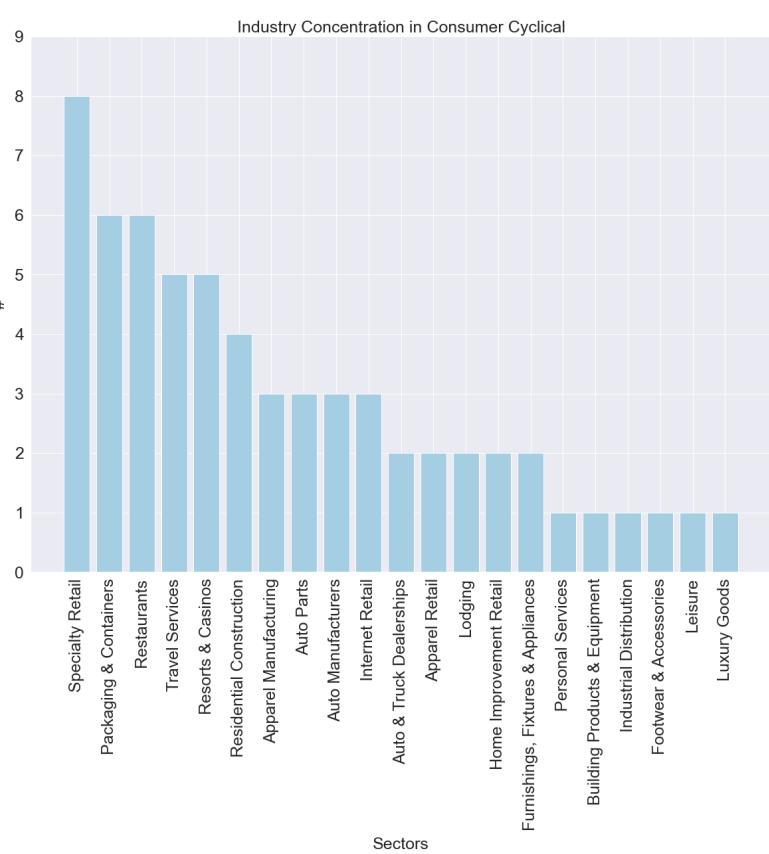


Fig.20.

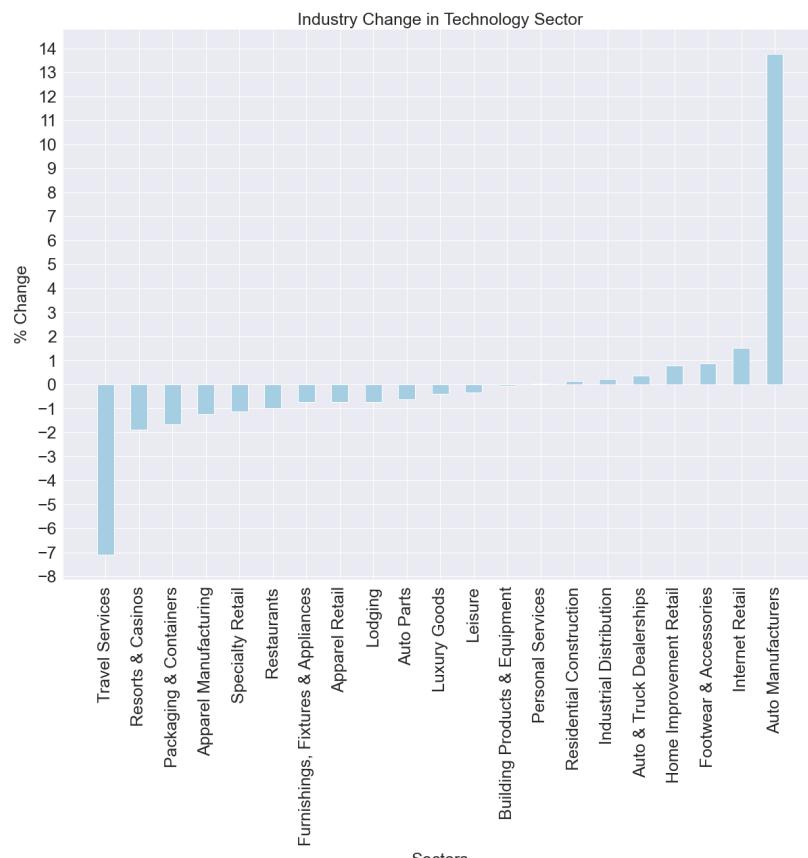


Fig.21.

Once again, one industry vastly outperformed the rest of the industries. In this case, it was the Auto-Manufacturers: GM, Ford, and Tesla. As an industry, it's % change in sector strength is over 7x the second highest change, Internet Retail. Although Ford and GM did well for themselves this increase is reflected by Tesla. As previously mentioned, Tesla experienced an unprecedented meteoric rise. Next we saw Internet Retail had the second highest % change. Online shopping through vendors like Etsy, Ebay, and Amazon saw a spike in activity because people were unable to or afraid to visit brick-and-mortars. On the opposite side, industries that relied on tourism or people traveling were hit the hardest.

## **Analysis Limitations**

One of our analysis' main limitations is the sample of data currently available to us. Our Pre-Covid data is expansive and comprehensive since it extends before late-2019. Our During-Covid sample, while smaller, is still rich enough to draw insights since it's about 2 years worth of data. However, our Post-Covid data may raise concerns since there isn't a year's worth of data yet. We started collection for Post-Covid analysis early 2022.

---

## **Appendix :**

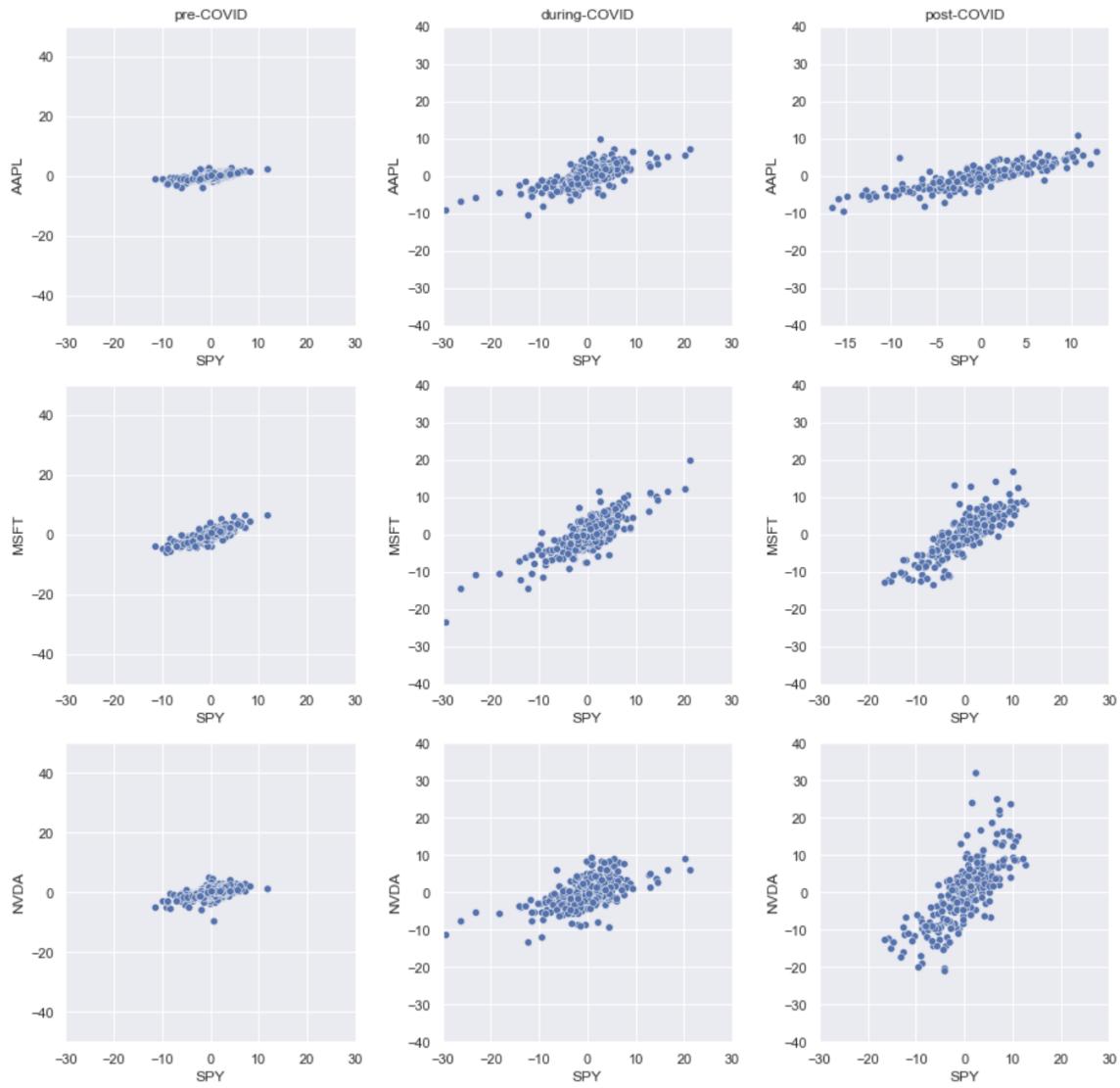
### **Appendix.1:**

First, we import each of these live data sets into our research after first obtaining them all via a free API provided by Yahoo Finance. We automatically chose these data for our three distinct periods for before, during, and after the covid period since we were reading these data using Pandas data reader. Additionally, these data were automatically transformed to a pandas data frame since we were using pandas to examine them.

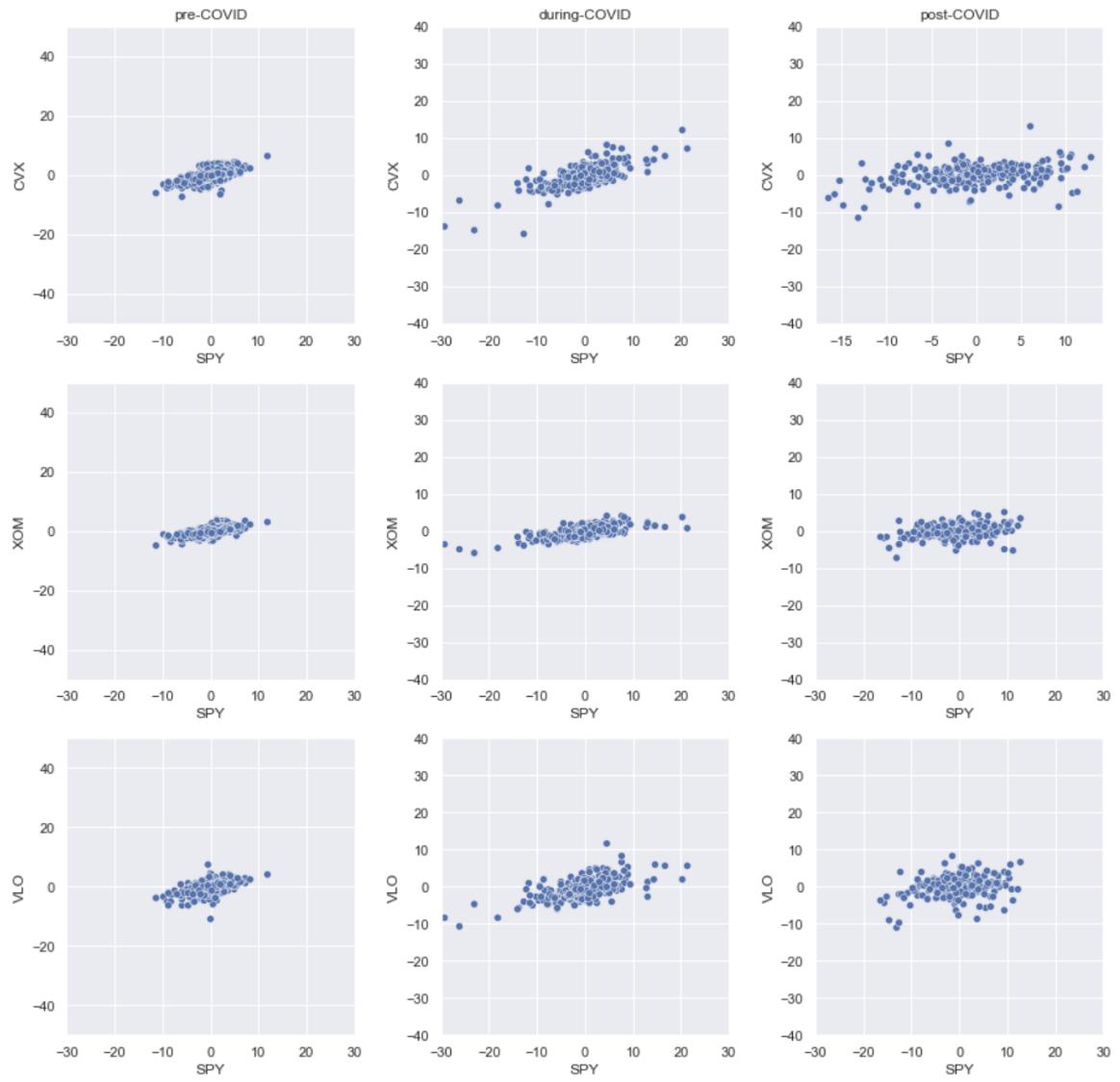
We were only interested in the closing price of each stock on a daily basis as a result of these imports, which resulted in a large amount of financial data. Therefore, we daily filtered the data frame for each industry according to its closing cost. Additionally, as we didn't want any nan values, we cleaned them. The data's outcome for one of our industries looked like this(this is a sample and only for during the COVID period:

Symbols	SPY	CVX	XOM	VLO
Date				
2019-08-09	291.619995	122.419998	70.839996	78.849998
2019-08-12	288.070007	121.550003	69.629997	77.150002
2019-08-13	292.549988	122.389999	70.489998	78.739998
2019-08-14	283.899994	117.739998	67.650002	76.000000
2019-08-15	284.649994	116.949997	67.250000	76.720001
...	...	...	...	...
2021-08-02	437.589996	101.629997	57.580002	66.400002
2021-08-03	441.149994	102.599998	58.200001	69.010002
2021-08-04	438.980011	100.300003	56.840000	64.180000
2021-08-05	441.760010	101.230003	57.200001	65.709999
2021-08-06	442.489990	101.949997	57.860001	66.500000

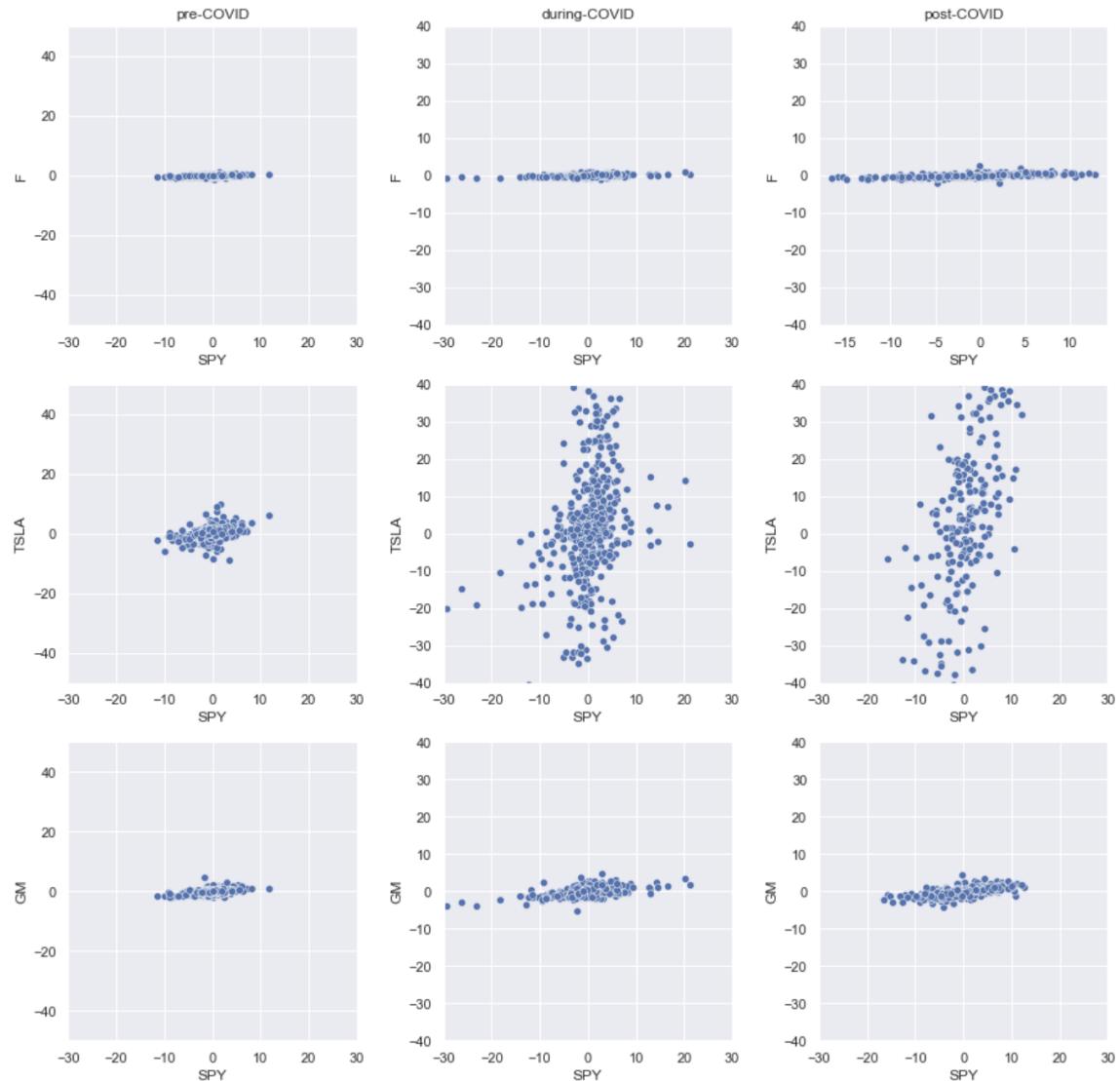
### **Appendix.2:**



### Appendix.3:



Appendix.4:



# Financial Market Performance and Sectors Analysis Pre-and-Post Covid

Amir Moazami, Svein Gonzalez, Kai Ding

Date: 8/6/2022

# Research Question #1

Is there a reliable correlation between the stock performance of the top three companies of top industries and the performance of the whole market(S&P500). Dow Jones, Nasdaq, and SP 500.

- We will analyze the performance of the top three companies in various industries (before, after and during COVID period) compare with overall performance of economic indicators like the S&P 500 will be examined.
- Compare the volatility (therefore the significance of these companies) before, during, and after the COVID period.
- Examine market performance before, during, and after the COVID period ( with three different indicators Dow Jones, Nasdaq, and SP 500)

# Assumptions

Establishing our general Assumptions:

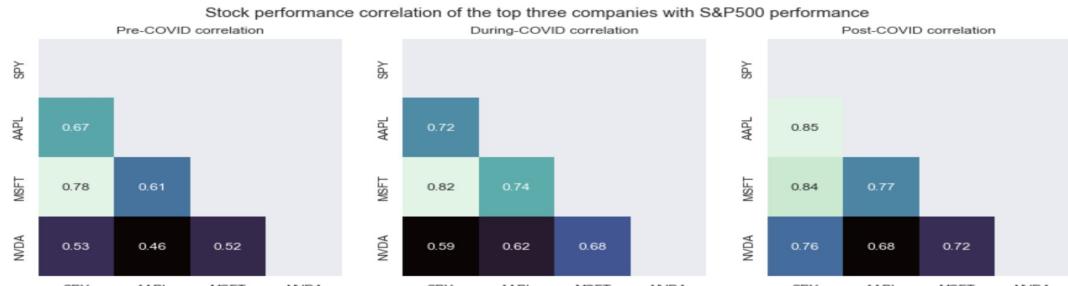
- Tech Industry Leaders:
  - Apple
  - Microsoft
  - Nvidia
- Energy Industry:
  - Chevron
  - Exxon
  - Valero
- Automotive Industry
  - Ford
  - Tesla
  - General Motors

Time periods:

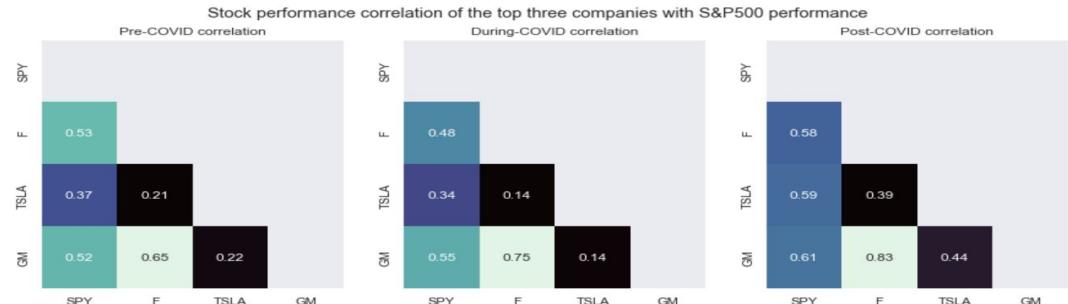
- Before Covid:
  - 5 years:
    - 2015 until 2019
- Covid Period:
  - 2 years
    - 2019 until 2021
- After Covid:
  - 1 year:
    - 2021 to Present

# Correlations:

Top 3 Tech companies VS SP500 :



Top 3 Automotive companies VS SP500 :



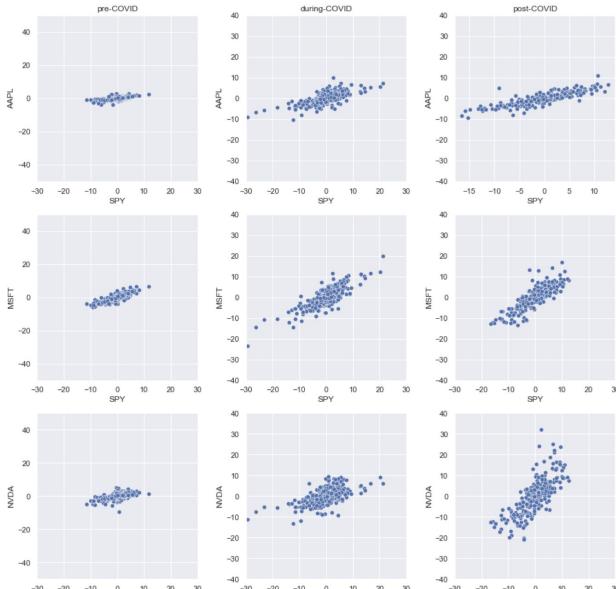
Top 3 Energy companies VS SP500 :



# Volatility analysis (Pre,Post,During Covid period):

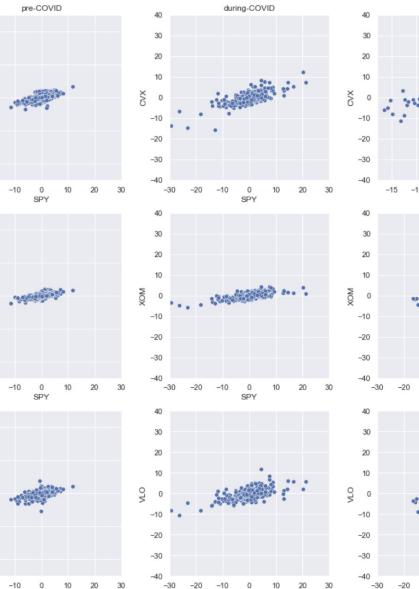
## Tech Sector:

(Apple, Microsoft, Nvidia)



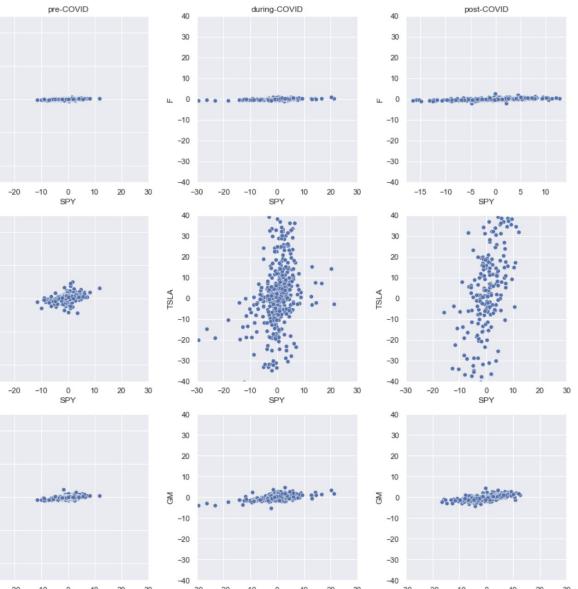
## Energy Sector:

(Chevron, Exxon, Valero)



## Automotive Sector:

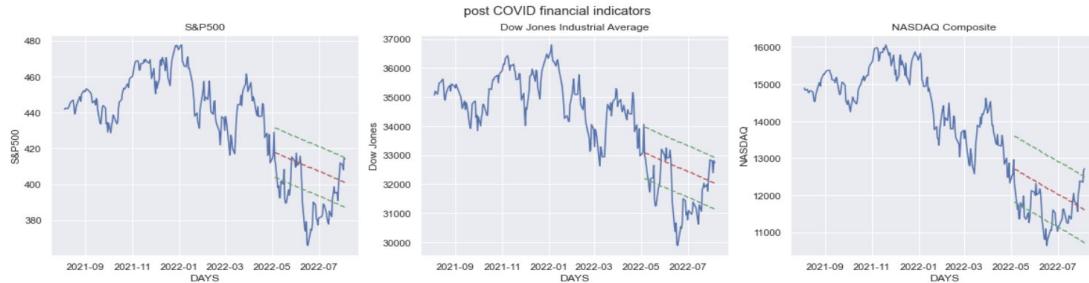
(Ford, Tesla, GM)



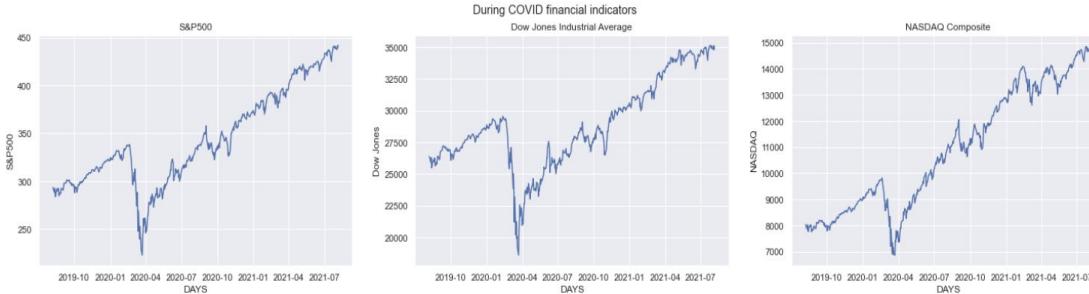
# Market Trends :

## (DowJones, Nasdaq, S&P500)

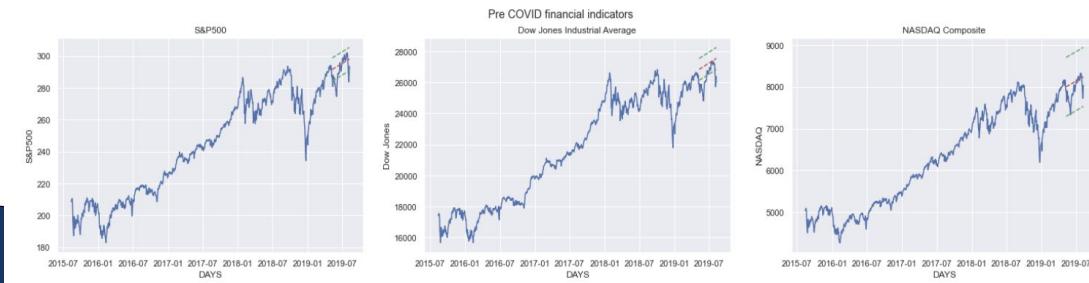
**After Covid Period :**



**During Covid Period :**



**Before Covid Period :**



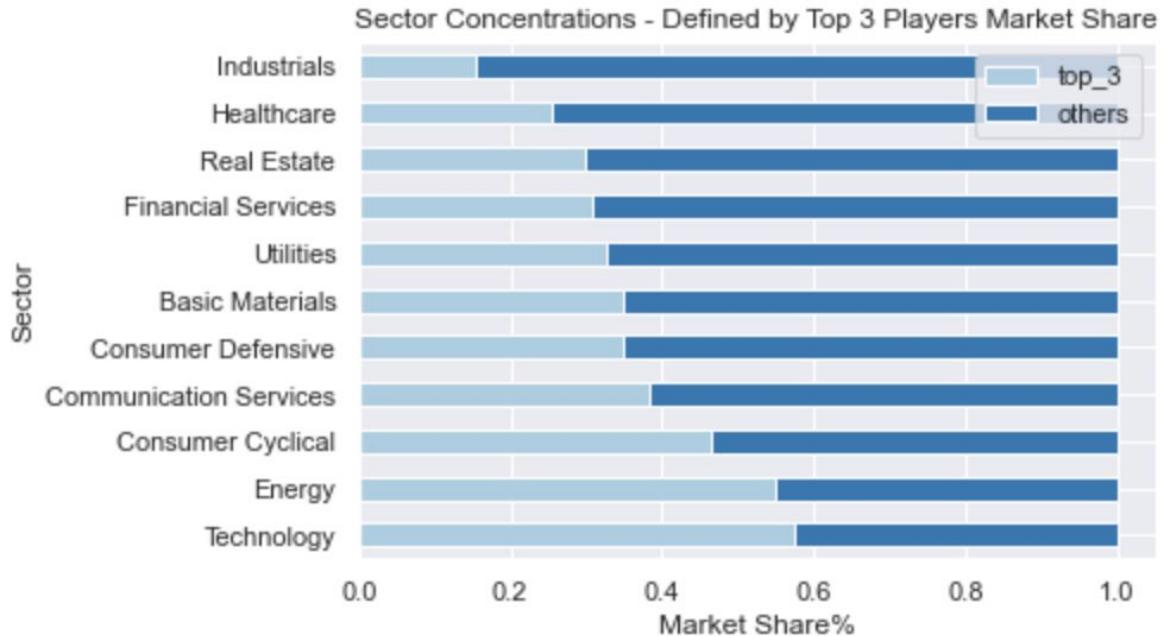
# Research Question #2

## Sector performance & leading players

- We will analyze top players' influence on their sectors
- We will identify important historical market trends, including the Covid's impact on sector performance

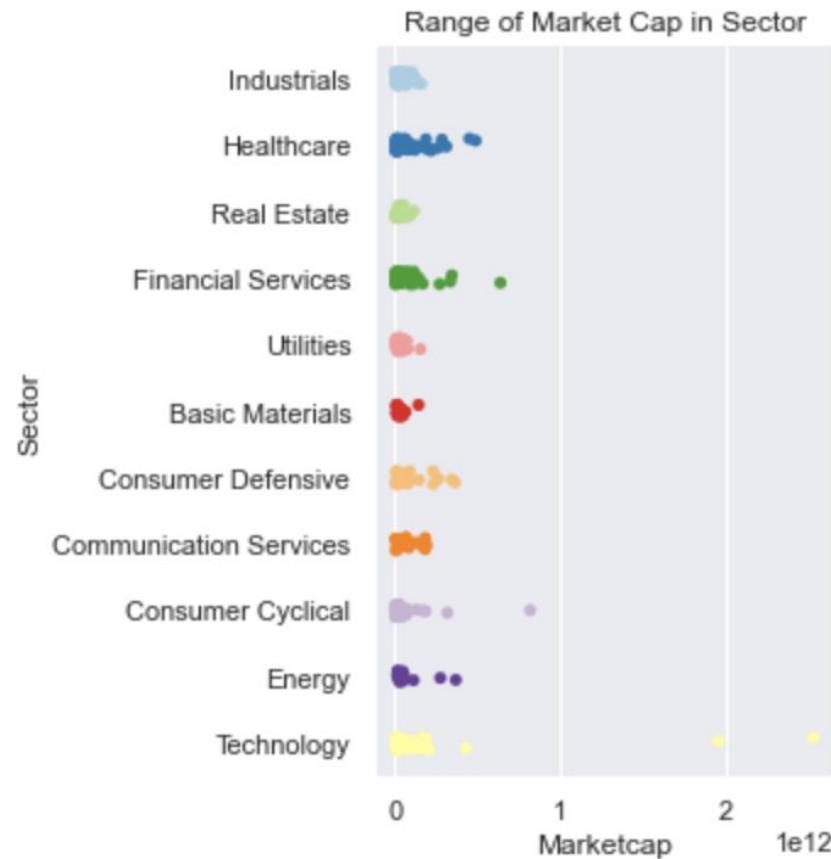
# Current top-3 player market share by sector

- The top 3 concentrated sectors are Technology, Energy, and Consumer Cyclical, with top players having ~40-60% of the sector market share



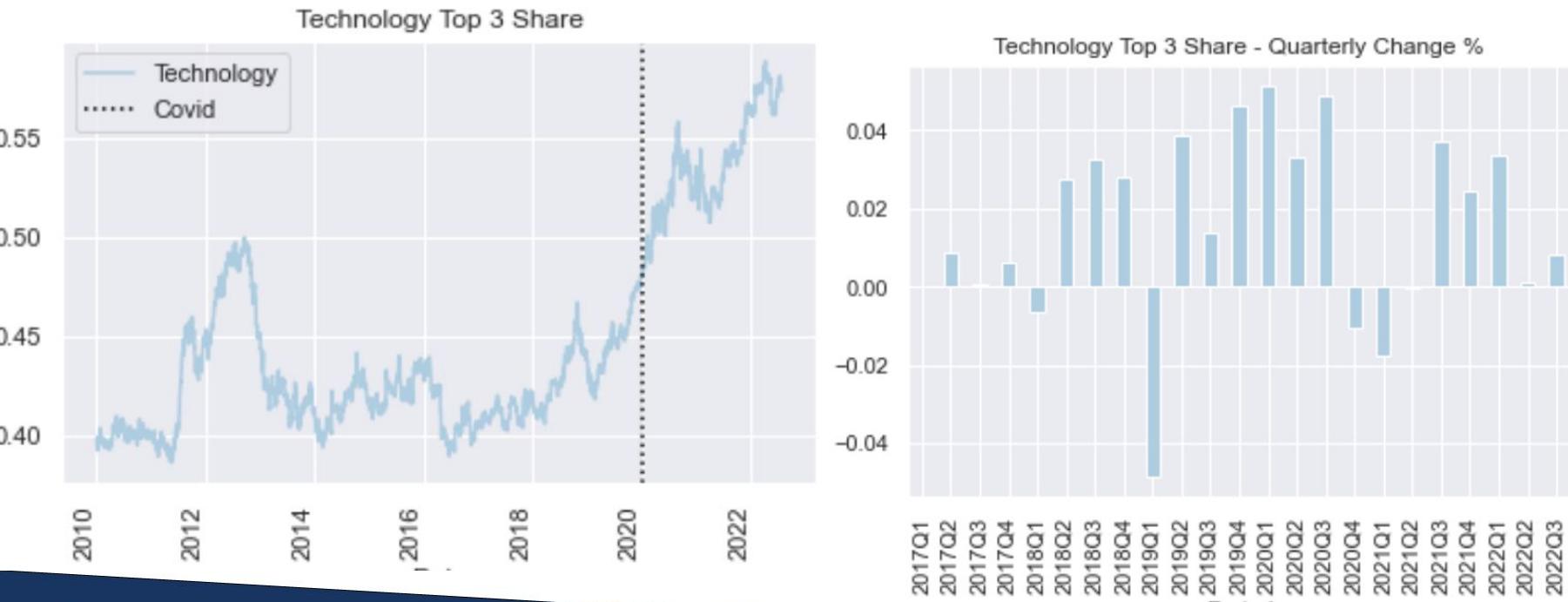
# Sector outliers

- Tech, Energy and Consumer Cyclical all have outliers, which are much bigger than the rest of the sector
- The gap between leading players and peer group is most dramatic in Tech



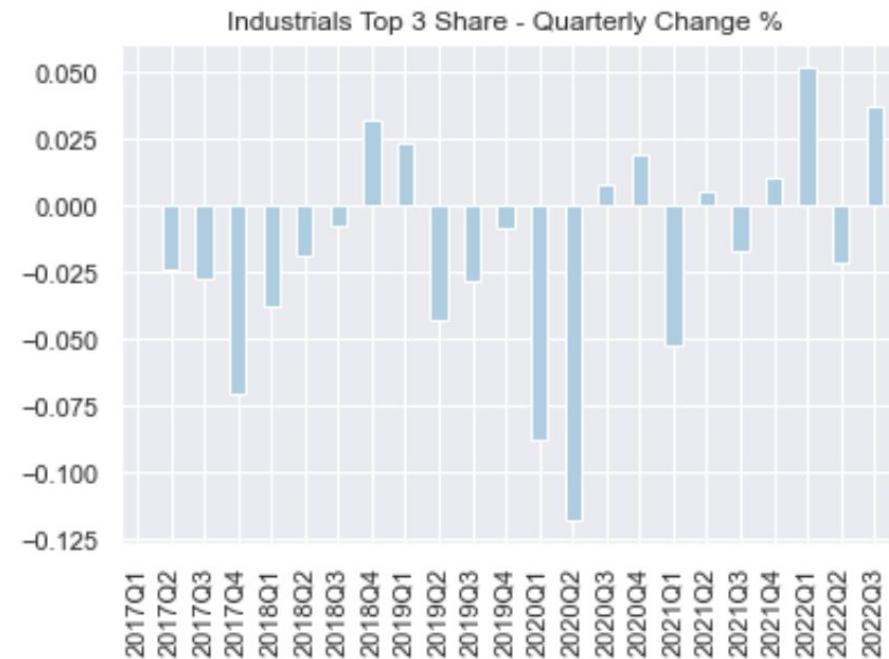
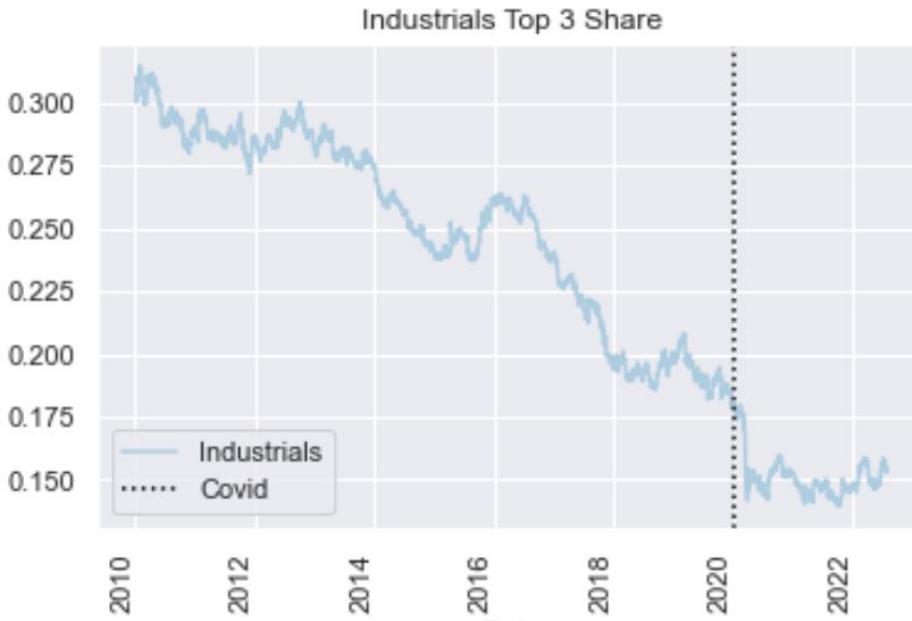
# Historical trend - Covid as a trend accelerator (Tech)

Top 3 players are gaining share in Tech, and Covid accelerated the upward trend



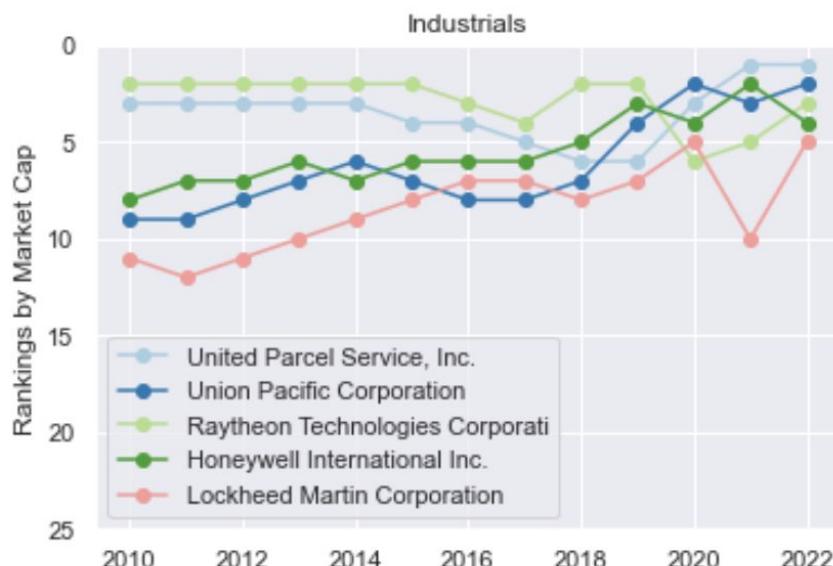
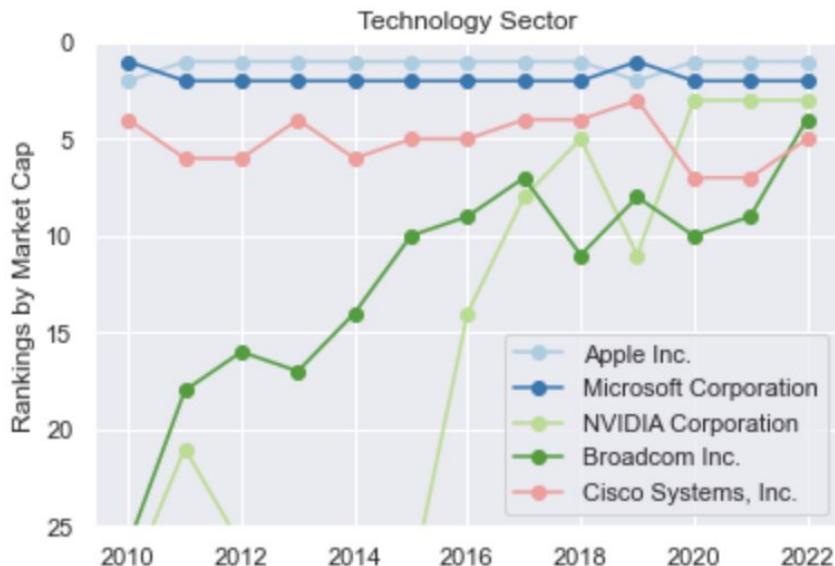
# Historical trend - Covid as a trend accelerator (Industrials)

Industrials has been declining in concentration, and Covid accelerated the decline

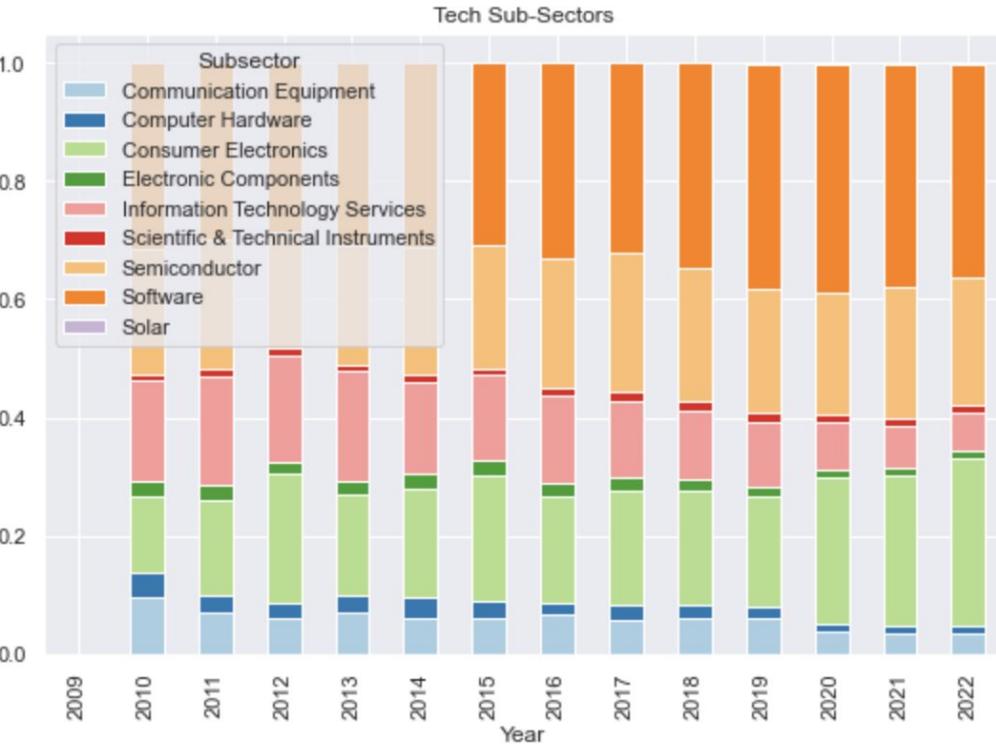


# Rise and fall of top players - Tech and Industrials

Tech is much more prone to disruptions from new players - a company can move from outside Top 25 to Top 3 in 5 years. The change is much more gradual in Industrials



# Tech deepdive - industry (sub-sector) performance

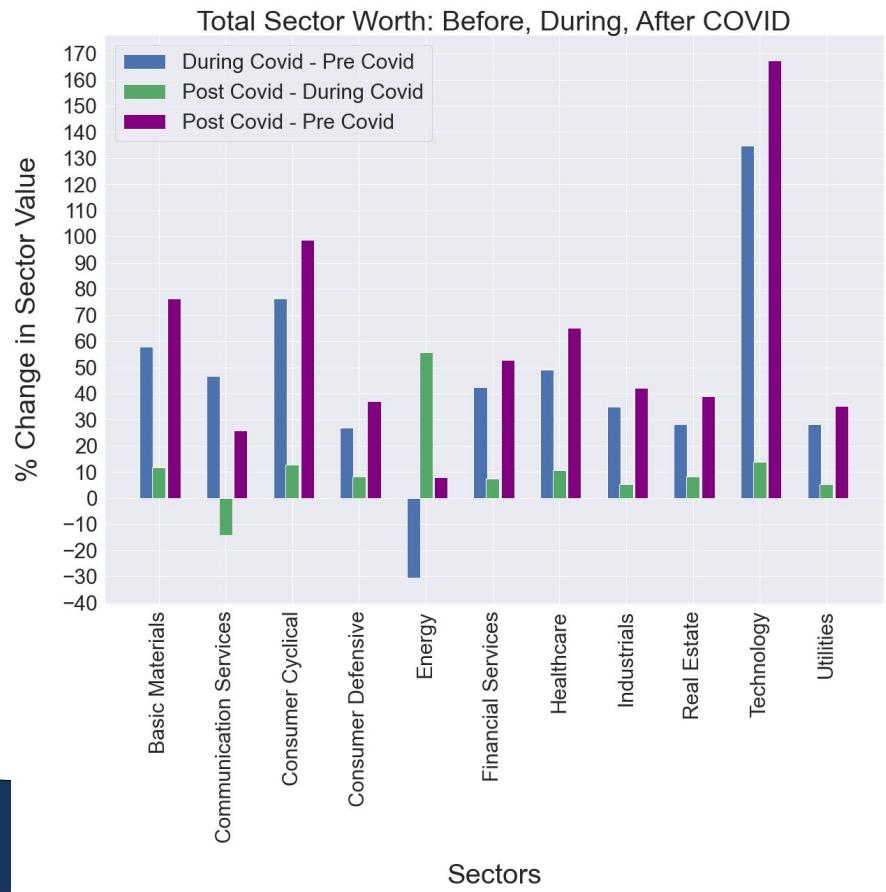
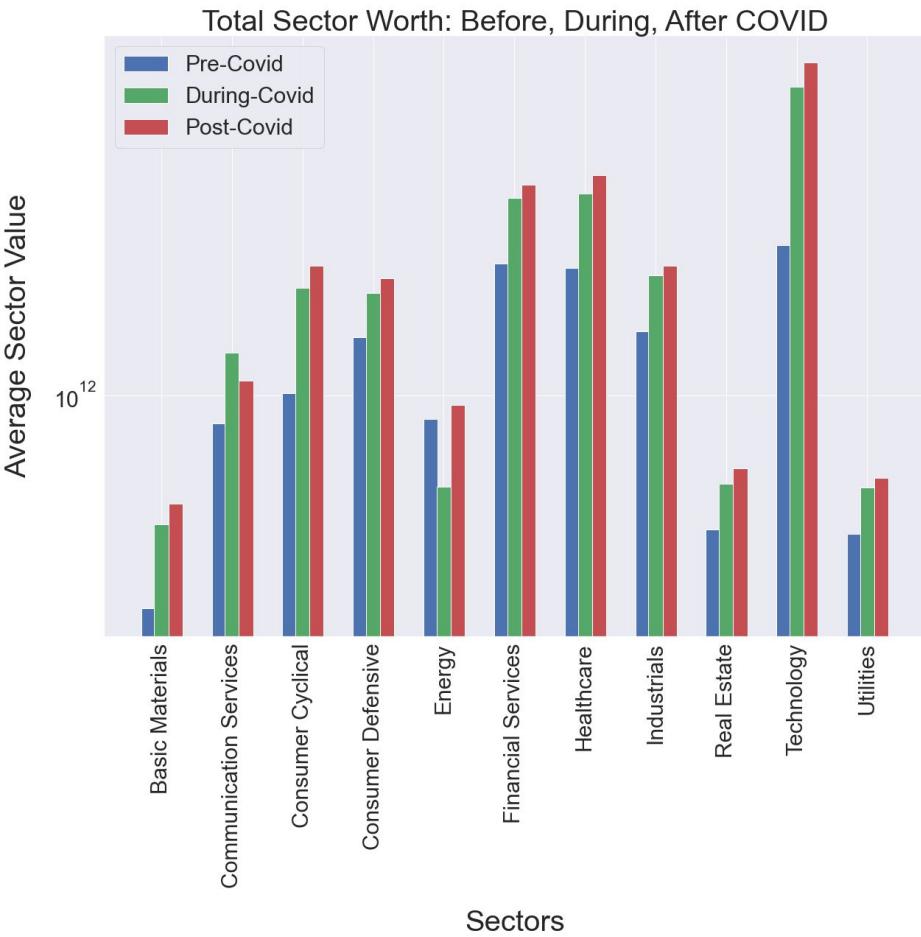


- Gaining industries: Software and Consumer Electronics (mainly driven by Apple) - “Software is eating the world”
- Stable industry: Semiconductor, potentially due to longer development cycle and capital requirements

# Research Question #3

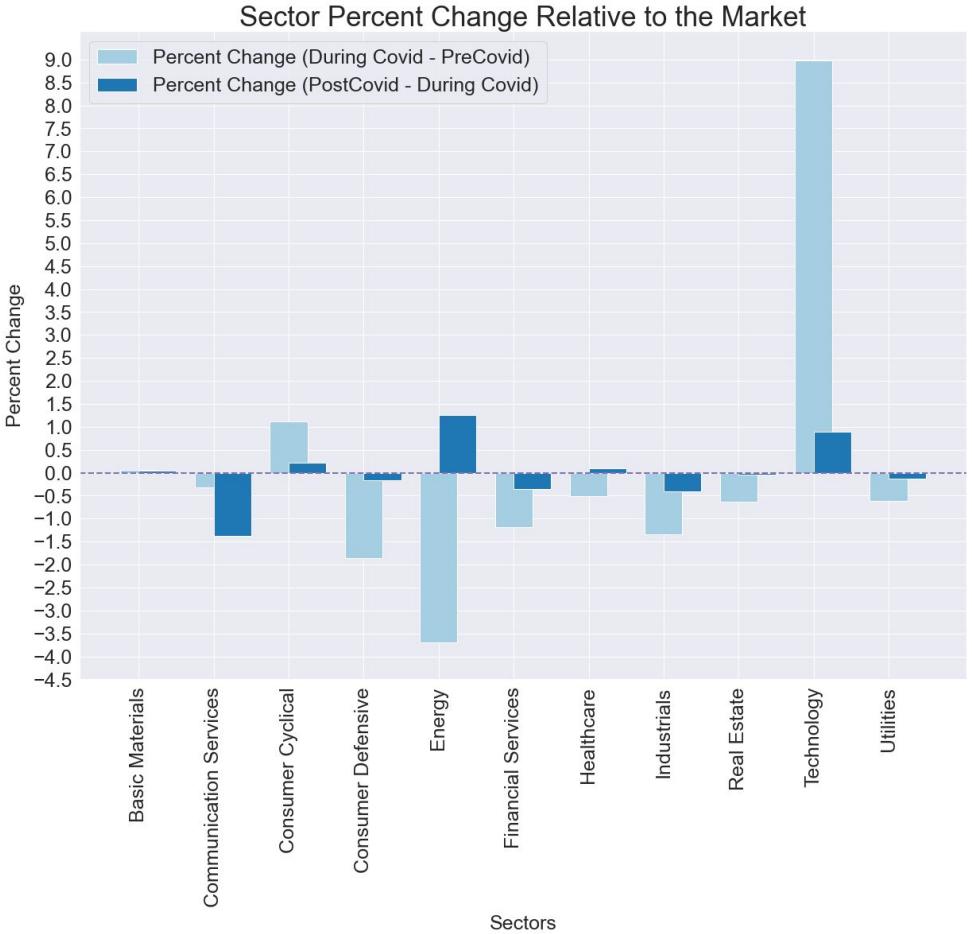
- Which industries were thriving throughout the pandemic?

# Sector Value: Pre, During, Post Covid



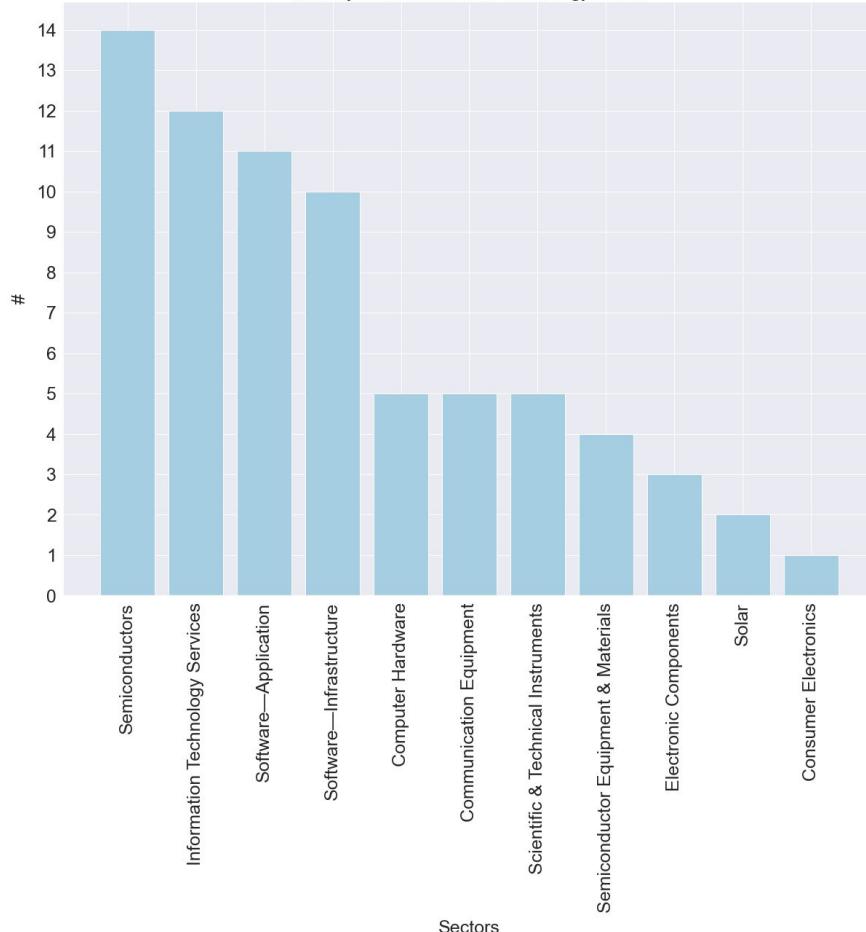
# Sector Value: Pre, During, Post Covid

- Which sectors were thriving throughout the pandemic?



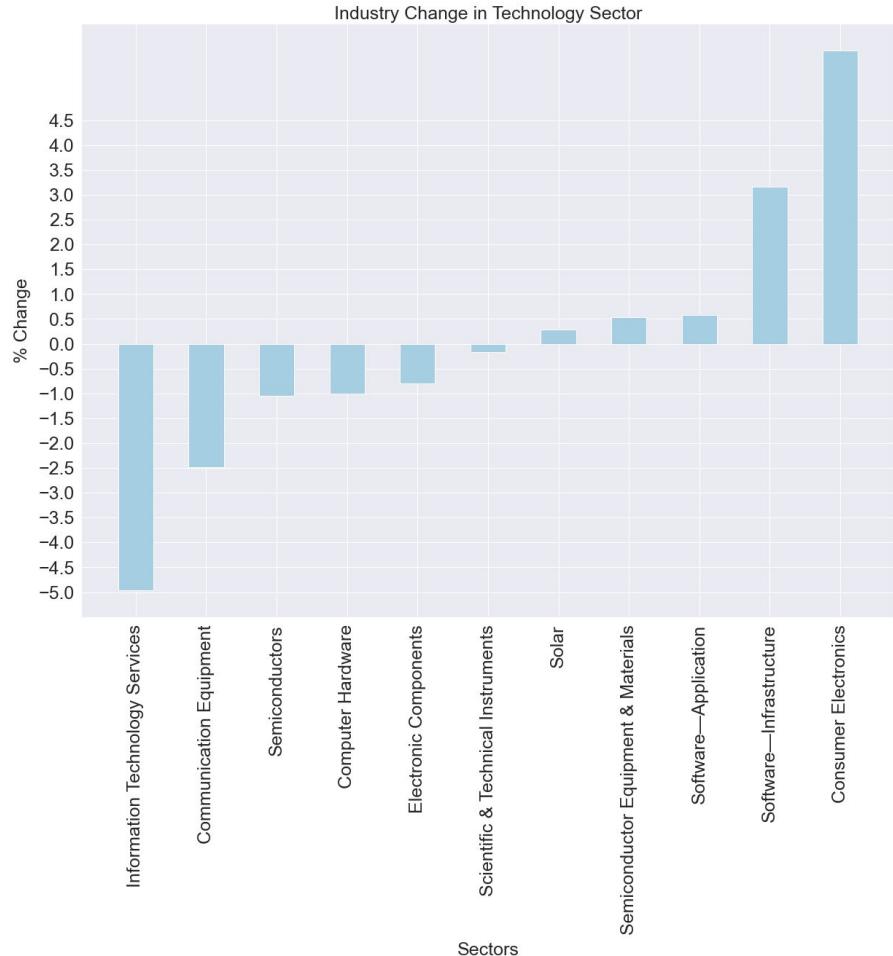
# Industry Breakdown in Technology

Which industry do you think  
saw the most growth in the  
Technology Sector?



# Industry Change in Technology Sector

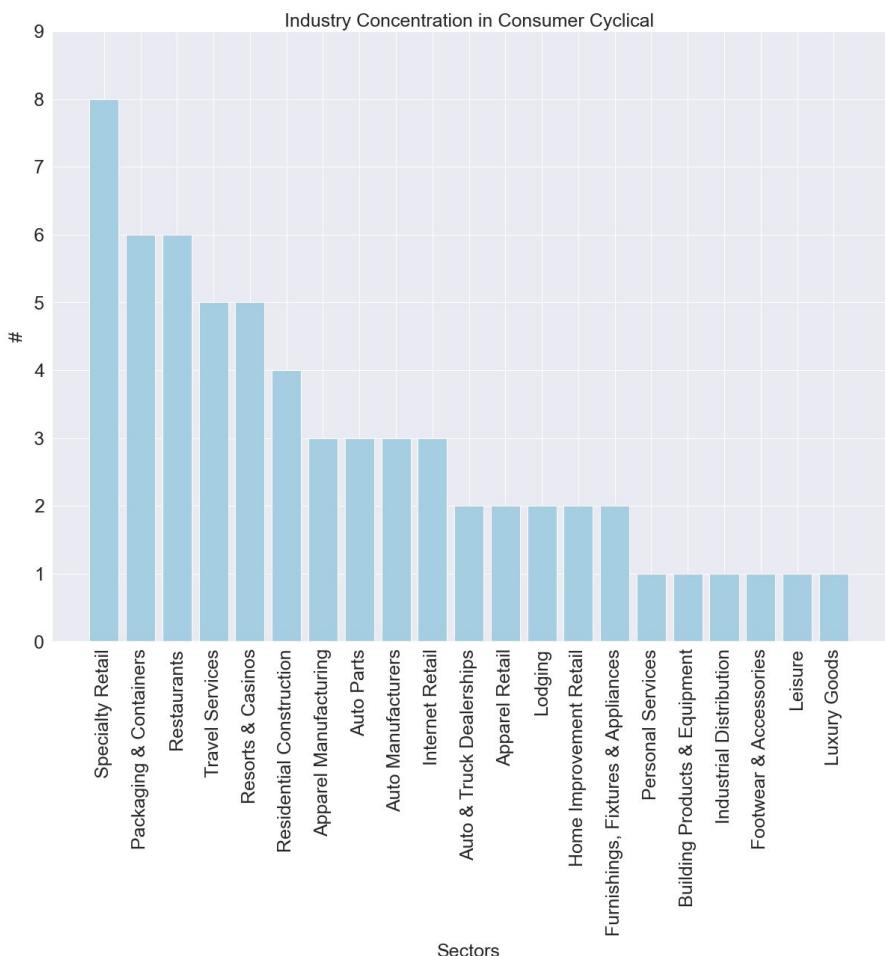
- Apple!



# Industry Breakdown in Consumer Cyclical

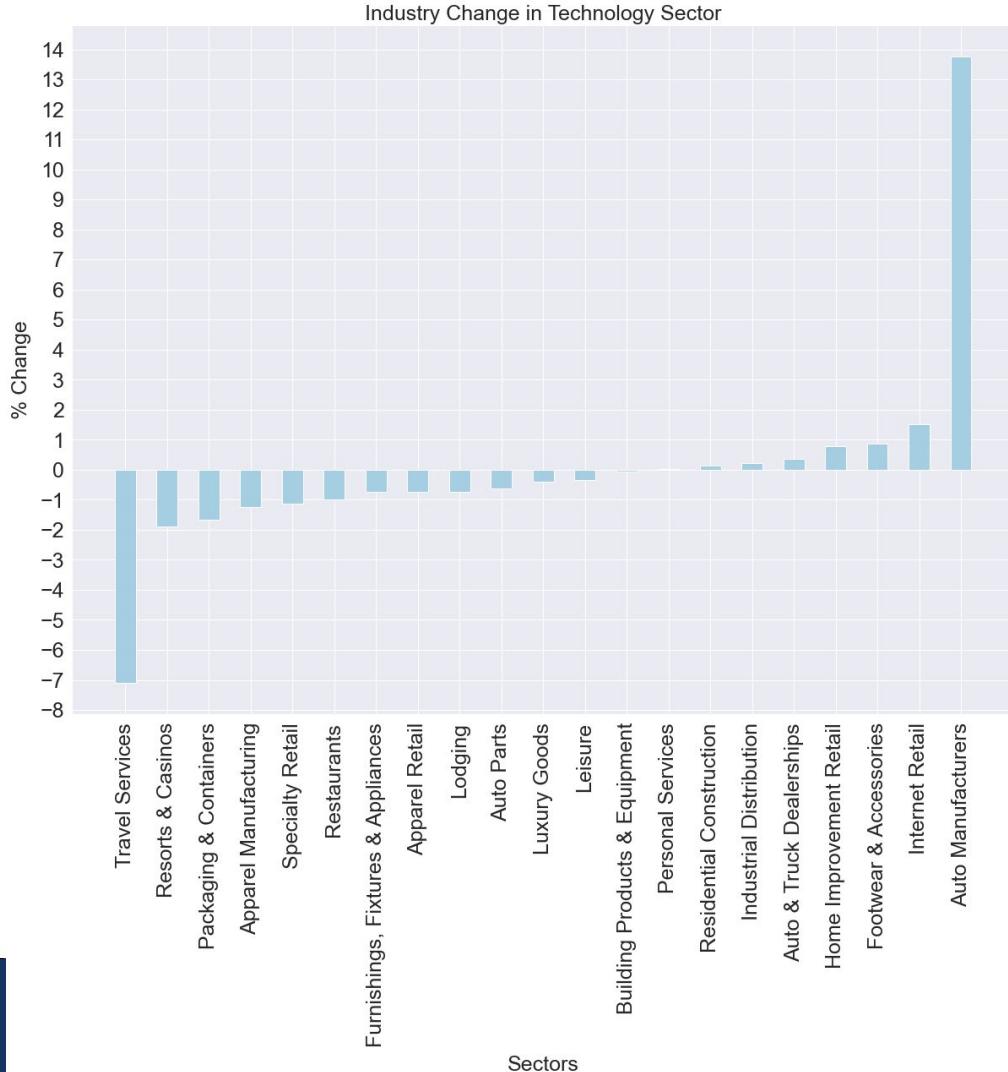
- Which industry do you think saw the most growth in the Consumer Cyclical?

Hint: The CEO likes to tweet



# Industry Change in Consumer Cyclical

- TESLA!



# Challenges

- Large number of variables:
  - 503 ticker symbols, 11 sectors and 114 industries in S&P 500, over 12 years
- Lots of exploratory analysis to identify unique insights:
  - S&P 500 is widely studied, and we also didn't know what to expect
  - To develop unique angles, we have to perform lots of EDA to test many different hypotheses
- Time-series data:
  - Have to wrangle time-series data over different periods (week, month, quarter, etc) to identify market trends
- Post-Covid data is more limited. We have less than a year's worth of data, as opposed to During-Covid (2 years) and Pre-Covid (5+ years).

The End