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Group-8:

Student Number	Student Surname (BLOCK CAPS)	Student name
21338931	ZEIN	ZIAD
21333344	MOHANA SUNDARAM	SARATH KUMAR
21333039	SHAHRAWAT	RITU
21330178	ZHANG	JINGXUAN

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Explanatory Analysis on Corporates' Supply Chain Data

Table of Contents:

I.	Abstract	3
II.	Supply Chain Data Set Introduction	3
III.	Business Problem.....	3
IV.	Business Goals	4
V.	Data Cleansing and Manipulation	4
VI.	Explanatory Data Analysis and Visualization	
1.	Data Discovery	6
2.	Covid-19's Financial Repercussions on Companies	
i.	ROA	7
ii.	Sales Revenue	10
iii.	Market Capitalization.....	14
VII.	Results	17
VIII.	Conclusions	19
IX.	Business Recommendations	20
X.	References	21
XI.	Appendices	22

Abstract

This paper introduces a Supply Chain Data Set for the most known corporations worldwide. Each of the companies specializes in different fields and sectors, varying from the tech industry to medicinal, consulting, and more. Financial data with various financial indicators are provided for each company from the third quarter of 2018 until the third quarter of 2020 (September 2018 – September 2020), covering periods before and after the Covid-19 pandemic that started in March 2020. After cleaning and manipulating the data, we perform explanatory analysis using various programs, models and statistical techniques to provide key insights and business recommendations.

Supply Chain Data Set Introduction

The initial supply chain dataset consisted of 84 variables and provided data records for 505 published companies (corporations) on the New York Stock Exchange. There are nine different time series variables representing ROA, Inventory Turnover, Historical Market Capitalization, SGA, Finishing Goods Inventory, WIP, Raw Materials Inventory, Sales Revenue and PPE from September 2018 to September 2020.

Business Problem

Businesses in most industries have been impacted either negatively or positively by the Covid-19 pandemic since its outbreak in March 2020. (Refer to Appendix A). Covid-19 has created huge uncertainties for businesses and their operations, resulting in difficulties in adapting to the pandemic and maintaining the same revenues, return on assets and market capitalization within the supply chain sector.

Business Goals

With the presence of supply chain data for the biggest 505 corporations and with the uncertainty of Covid-19's financial impact on the supply chain sector, we perform explanatory analysis to identify Covid-19's financial repercussions on these companies.

- Explain and interpret Covid-19's impact on companies' revenues, ROA and market capitalization.
- Identify the best & worst performing companies prior to and after Covid-19's impact.

Data Cleansing and Manipulation

After thoroughly examining the data set and before proceeding to explanatory analysis, it is crucial to perform various data cleansing and manipulation techniques. Using the “IFCOUNT” function in excel, we identify a total of 11753 missing values, “NA”, out of 28647 data instances, accounting for almost 40%. With the presence of an abundant number of missing data in our data set, data cleansing is necessary to improve data quality and reduce any bias or error that might result from explanatory analysis. In addition, it is difficult to deal with and interpret results with the presence of missing data.

To determine what to do with the missing values present in our data set, we dug deep and tried to understand the reason for the missing data. It is significant to determine if the data is missing at random or not because different cleansing techniques are performed. We begin by identifying missing data not at random by observing different variables/columns, and we determine that most companies had missing data within the following variables relative to other variables: Inventory Turnover, SGA, Finished Goods, WIP, Raw Materials and PPE. due to insufficient data.

We import our data set into R and drop the mentioned variables/columns as we are left with the following variables: ID, Company, Equity, ROA, Historical Market Capital, Revenues, Number of Employees and Country Count. We use the “IFCOUNT” excel function again on the remaining data, and we identify that the number of missing values dropped from 11753 to an astonishing 181 only.

We recognized that R categorizes the values as a character instead of numeric when running summary statistics. To perform imputation of missing values, data should be in numeric format, so we convert the whole data points into numeric using the sapply() and as.numeric() functions.

With only 181 missing values remaining in our data set scattered all around 505 records, we identify that these missing values are missing at random except for 11 records or companies who barely have any data. We delete these records from the data set because of the lack of sufficient data to perform any explanatory analysis. To impute the remaining missing data, we refer to the “HMISC” package in R, which handles missing data and computes them according to a specific technique of our choice. We impute the missing values using the impute() function using a random technique on all columns. We run summary statistics on the data set and determine 0 missing values remain.

Since our focus is to determine the impact of Covid-19 on the companies’ financial standings and data, we create the variables: ROA_Pre_Covid, ROA_Post_Covid, Sales_Revenue_Pre_covid, Sales_Revenue_Post_Covid, Historical_Market_Cap_Pre_Covid, Historical_Market_Cap_Post_Covid. The variables for pre covid take the mean of the original columns in our data set prior to March 2020, and for the variables for post covid take the mean of the original columns after March 2020.

We finally obtain a complete and simple data set that can be efficiently used to perform summary statistics and explanatory analysis, with a total of 494 records and 10 columns. Refer to Appendix B for a sample shot of the imputed and cleaned data set.

Explanatory Data Analysis and Visualisation

1. Data Discovery

In this part, we discover the variable types and summary statistics of our final dataset after data cleansing. Firstly, we used `str()` function to check the internal structure of all the chosen variables. Now, we have 494 records and 10 variables as Fig 1.1:

```
> str(supply_chain_df_final)
'data.frame': 494 obs. of 10 variables:
 $ Company.x           : chr "Microsoft Corporation" "Apple Inc." "Amazon.com Inc." "Facebook Inc. Class A" ...
 $ Equity.x             : chr "MSFT US EQUITY" "AAPL US EQUITY" "AMZN US EQUITY" "FB US EQUITY" ...
 $ NUM_OF_EMPLOYEES     : num 144000 137000 798000 44942 118899 ...
 $ Country_Count        : num 6 5 9 6 6 6 4 6 5 ...
 $ ROA_Pre_Covid        : num 13.38 15.97 6.94 19.31 12.93 ...
 $ ROA_Post_Covid       : num 16.1 17.63 6.12 17.97 12.6 ...
 $ Hitorical.Market.Cap_Pre_Covid : num 974720 971227 884669 494521 815281 ...
 $ Hitorical.Market.Cap_Post_Covid: num 1442910 1497435 1307716 623037 918003 ...
 $ Sales_revenue_Pre_Covid   : num 32634 69149 68247 16890 39146 ...
 $ Sales_revenue_Post_Covid : num 36736 60899 86836 19298 41876 ...
```

Figure 1.1

To get a better idea of the distribution of variables in our new dataset, we used the `summary()` function and got the following output (Fig 1.2):

```
> summary(supply_chain_df_final)
Company.x           Equity.x           NUM_OF_EMPLOYEES  Country_Count  ROA_Pre_Covid    ROA_Post_Covid
Length:494          Length:494          Min. : 0          Min. : 0.00      Min. :-17.547   Min. :-50.330
Class :character    Class :character  1st Qu.: 8625      1st Qu.: 1.00      1st Qu.: 2.729   1st Qu.: 1.545
Mode  :character    Mode  :character  Median : 18702     Median : 2.00      Median : 6.214    Median : 4.691
                           Median : 51755     Mean  : 3.03      Mean  : 7.346    Mean  : 5.437
                           Mean  : 51755     3rd Qu.: 5.00      3rd Qu.: 10.620   3rd Qu.: 9.046
                           3rd Qu.: 51408     Max.  :11.00      Max.  : 37.758   Max.  : 55.243
                           Max.  :2200000    Max.  : 12.00     Max.  : 37.758   Max.  : 55.243
Hitorical.Market.Cap_Pre_Covid Hitorical.Market.Cap_Post_Covid Sales_revenue_Pre_Covid Sales_revenue_Post_Covid
Min.   : 5053          Min.   : 1919          Min.   : 120.9      Min.   : 172.6
1st Qu.: 12603         1st Qu.: 11257        1st Qu.: 1207.1    1st Qu.: 1110.7
Median : 22372         Median : 20872        Median : 2492.7    Median : 2309.6
Mean   : 52102         Mean   : 54595        Mean   : 6161.4    Mean   : 5900.0
3rd Qu.: 45421         3rd Qu.: 47705        3rd Qu.: 5474.9    3rd Qu.: 4751.5
Max.   :974720         Max.   :1497435       Max.   :131275.2   Max.   :135690.7
```

Figure 1.2

From Fig 1.2, we can say that COVID has adversely affected the companies' ROA and market value. The minimum value for ROA_Post_Covid and Historical.Market.Cap_Post_Covid has extremely declined as compared to pre covid. To know more about the impact of COVID on companies' ROA, Sales revenue and market value we dug deep and used MySQL to find out the most and least affected companies.

2. Covid-19's financial repercussions on the companies. (Using MySql and Tableau)

To identify the effect of COVID-19 on the financial performance of the companies, we compared their ROA, sales revenue and market value before and after March 2020. By using some queries in MySQL, we were able to find out the best and worst-performing companies based on their ROA, sales revenue and Market value.

In terms of ROA:

- Top 25 companies with the highest ROA pre and post covid

ID	Company	ROA_Pre_Covid
298	Domino's Pizza Inc.	37.75808333333333
70	Vertex Pharmaceuticals Incorporated	31.8193
181	Yum! Brands Inc.	29.63408333333333
50	Texas Instruments Incorporated	29.35968333333333
219	VeriSign Inc.	28.36781666666667
68	Intuit Inc.	27.18408333333333
14	Mastercard Incorporated Class A	27.01808333333333
255	MarketAxess Holdings Inc.	26.17971666666667
16	NVIDIA Corporation	25.67311666666667
384	ABIOMED Inc.	25.00718333333333
358	NVR Inc.	24.93495
195	IDEXX Laboratories Inc.	24.10536666666667
259	Copart Inc.	23.93901666666667
177	T. Rowe Price Group	23.55235
13	Home Depot Inc.	23.4325
152	Ross Stores Inc.	23.09233333333333
220	Fastenal Company	23.03011666666667
183	Monster Beverage Corporation	21.68581666666667
443	Robert Half International Inc.	21.27696666666667
67	S&P Global Inc.	20.40581666666667
148	Electronic Arts Inc.	20.10441666666667
239	Skyworks Solutions Inc.	20.01368333333333
254	Mettler-Toledo International Inc.	19.91543333333333
139	Lam Research Corporation	19.81635
4	Facebook Inc. Class A	19.31233333333333

Figure 2.1

ID	Company	ROA_Post_Covid
264	Align Technology Inc.	55.2429
219	VeriSign Inc.	43.1161
387	NRG Energy Inc.	37.606
298	Domino's Pizza Inc.	33.53923333333333
347	NortonLifeLock Inc.	32.76443333333333
203	Cadence Design Systems Inc.	31.278
50	Texas Instruments Incorporated	28.3794
255	MarketAxess Holdings Inc.	26.90476666666667
14	Mastercard Incorporated Class A	26.1552
324	Masco Corporation	25.62953333333333
153	eBay Inc.	25.34983333333333
195	IDEXX Laboratories Inc.	25.2187
70	Vertex Pharmaceuticals Incorp...	24.1004
67	S&P Global Inc.	23.3529
259	Copart Inc.	22.92273333333333
183	Monster Beverage Corporation	22.62513333333333
177	T. Rowe Price Group	22.3216
100	Biogen Inc.	21.5478
68	Intuit Inc.	21.39566666666667
220	Fastenal Company	21.1951
358	NVR Inc.	20.60103333333333
254	Mettler-Toledo International Inc.	20.5818
13	Home Depot Inc.	20.45443333333333
148	Electronic Arts Inc.	20.35096666666667
24	Adobe Inc.	19.82366666666667

Figure 2.2

From the above results in **Figure 2.1 and 2.2**, we found that Vertex Pharmaceuticals Incorporated, Yum! Brands Inc., Intuit Inc., ABIOMED Inc. are the companies that have

slipped down from the top 25 companies' list post covid. Whereas, Align Technology Inc., NRG Energy Inc., NortonLifeLock Inc., Cadence Design Systems Inc., Masco Corporation are some of the companies who make it to the top 25 list of highest ROA post covid.

- **Bottom 25 companies with lowest ROA pre and post covid**

ID	Company	ROA_Pre_Covid
453	Newell Brands Inc	-17.5467833333333
464	National Oilwell Varco Inc.	-17.2049166666667
494	Coty Inc. Class A	-10.5424333333333
485	TechnipFMC Plc	-6.72945
380	DENTSPLY SIRONA Inc.	-5.369266666666667
98	General Electric Company	-5.113866666666667
142	DexCom Inc.	-5.07148333333333
250	Kraft Heinz Company	-4.62913333333333
201	Schlumberger NV	-3.92823333333333
458	Nielsen Holdings Plc	-3.7097
465	Apache Corporation	-3.677866666666667
246	Dollar Tree Inc.	-3.48805
467	News Corporation Class A	-3.40575
493	News Corporation Class B	-3.40575
335	Hess Corporation	-2.84695
283	Cardinal Health Inc.	-2.62383333333333
455	Noble Energy Inc.	-2.5774
260	Equifax Inc.	-1.78648333333333
302	Hologic Inc.	-1.560516666666667
331	Western Digital Corporati...	-1.23725
131	Autodesk Inc.	-0.64973333333333...
204	McKesson Corporation	-0.3082666666666...
198	American International G...	-0.0456166666666...
468	Mosaic Company	0.07413333333333
374	Baker Hughes Company...	0.2958

Figure 2.3

ID	Company	ROA_Post_Covid
355	Concho Resources Inc.	-50.3298
465	Apache Corporation	-45.7551
464	National Oilwell Varco Inc.	-32.0782333333333
201	Schlumberger NV	-29.59586666666667
455	Noble Energy Inc.	-27.43016666666667
485	TechnipFMC Plc	-25.50856666666667
374	Baker Hughes Company Class A	-22.87446666666667
461	Devon Energy Corporation	-20.3664333333333
469	DXC Technology Co.	-17.4302
335	Hess Corporation	-14.94966666666667
371	Halliburton Company	-14.76046666666667
442	Carnival Corporation	-14.34006666666667
492	Under Armour Inc. Class A	-13.7154333333333
486	Norwegian Cruise Line Holding...	-12.5438
328	Occidental Petroleum Corporation	-12.22976666666667
426	Diamondback Energy Inc.	-11.04696666666667
262	Incyte Corporation	-10.04006666666667
211	Marathon Petroleum Corporation	-8.76593333333333
494	Coty Inc. Class A	-8.728666666666667
417	Wynn Resorts Limited	-8.1629
479	PVH Corp.	-7.25793333333333
489	Gap Inc.	-7.072866666666667
467	News Corporation Class A	-7.03473333333333
493	News Corporation Class B	-7.03473333333333
431	Live Nation Entertainment Inc.	-7.00223333333333

Figure 2.4

From **Fig. 2.3 and 2.4**, we can identify that National Oilwell Vanco Inc., TechnipFMC Plc are the two companies who are still in the bottom list of lowest ROA post covid which means COVID hit some companies badly that has declined their ROA.

- **Effect on ROA of all the companies pre and post covid**

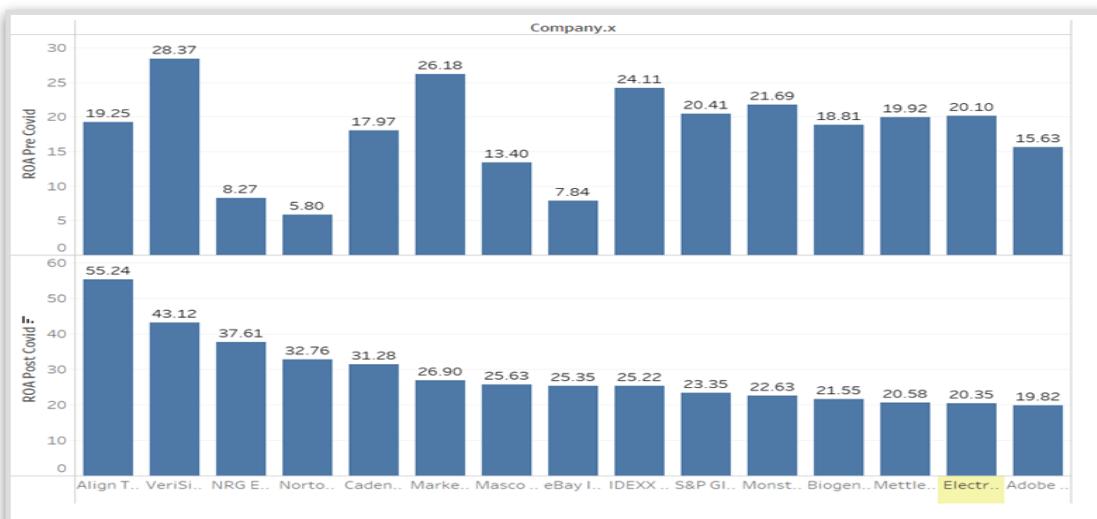
After checking the best and worst companies based on their ROA, we calculated the difference of ROA_Pre_Covid and ROA_Post_Covid for all companies to see whether it has impacted the company positively or negatively. If the effect is positive, it means the ROA of that company has increased post covid and decreased if the effect is negative.

ID	Company	ROA_Pre_Covid	ROA_Post_Covid	difference	effect
355	Concho Resources Inc.	4.231266666666667	-50.3298	54.561066666666667	Negative
465	Apache Corporation	-3.677866666666667	-45.7551	42.07723333333325	Negative
264	Align Technology Inc.	19.24541666666667	55.2429	35.9974833333333	Positive
461	Devon Energy Corporation	9.42735	-20.3664333333333	29.7937833333333	Negative
387	NRG Energy Inc.	8.2663	37.606	29.3397	Positive
347	NortonLifeLock Inc.	5.797216666666667	32.7644333333333	26.967216666666663	Positive
201	Schlumberger NV	-3.9282333333333	-29.59586666666667	25.66763333333337	Negative
455	Noble Energy Inc.	-2.5774	-27.43016666666667	24.85276666666667	Negative
374	Baker Hughes Company Class A	0.2958	-22.87446666666667	23.17026666666667	Negative
442	Carnival Corporation	6.6715	-14.34006666666667	21.011566666666702	Negative
469	DXC Technology Co.	1.49958333333333	-17.4302	18.92978333333333	Negative
485	TechnipFMC Plc	-6.72945	-25.50856666666667	18.77911666666667	Negative
486	Norwegian Cruise Line Holding...	6.21545	-12.5438	18.759249999999998	Negative
328	Occidental Petroleum Corporation	6.19293333333333	-12.22976666666667	18.42270000000003	Negative
262	Incyte Corporation	8.3747	-10.04006666666667	18.41476666666667	Negative
196	Twitter Inc.	15.04176666666667	-3.19913333333333	18.24090000000003	Negative
371	Halliburton Company	3.17315	-14.76046666666667	17.93361666666667	Negative
153	eBay Inc.	7.83746666666667	25.3498333333333	17.51236666666663	Positive
152	Ross Stores Inc.	23.0923333333333	5.837566666666667	17.25476666666663	Negative
426	Diamondback Energy Inc.	5.05465	-11.04696666666667	16.10161666666667	Negative
489	Gap Inc.	8.83693333333333	-7.072866666666667	15.9098	Negative
464	National Oilwell Varco Inc.	-17.20491666666667	-32.0782333333333	14.87331666666666	Negative
219	VeriSign Inc.	28.36781666666667	43.1161	14.74828333333301	Positive
471	Tapestry Inc.	8.671566666666667	-5.656366666666667	14.32793333333341	Negative
114	Micron Technology Inc.	19.01326666666667	4.7972	14.216066666666698	Negative
82	TJX Companies Inc	18.28931666666667	4.1987	14.0906166666666701	Negative

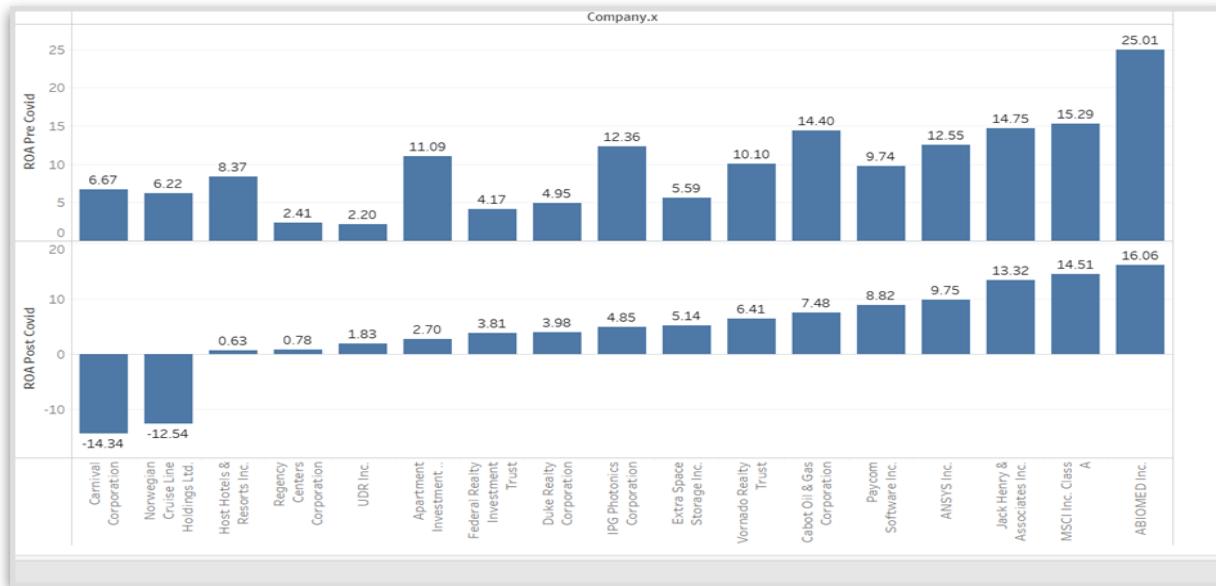
Figure 2.5

By analysing the above results (Fig 2.5) we found that the COVID has a negative impact on 337 companies (out of 494), which means because of the pandemic the net income of these companies has declined and the ROA of the remaining 157 companies has increased. We have also visualised the effect on ROA of all the companies using Tableau.

Companies with increased ROA post covid (Plot-1)



Companies with decreased ROA post covid (Plot-2)



In Plot-1, we visualised the positive effect on companies' ROA post covid. Some companies like Align Technology Inc., NRG Energy etc. are those whose net income has increased post-COVID. Whereas, in Plot-2, we can see there are some companies like Carnival Corporation, Norwegian Cruise Line Holdings Limited, whose ROA decreased drastically and went negative post covid.

In terms of Sales Revenue:

- Top 25 Companies with the Highest Sales revenue pre and post covid

ID	Company	Sales_revenue_Pre_Covid
28	Walmart Inc.	131275.1666666667
2	Apple Inc.	69148.8333333333
3	Amazon.com Inc.	68246.8333333333
22	Exxon Mobil Corporation	66337.1666666667
64	CVS Health Corporation	59781.6666666667
11	UnitedHealth Group Incorporated	59521.3333333333
204	McKesson Corporation	55704.6666666667
17	AT&T Inc.	45820.8333333333
301	AmerisourceBergen Corporation	45125.1665
221	Ford Motor Company	39226.5
5	Alphabet Inc. Class A	39145.5
6	Alphabet Inc. Class C	39145.5
39	Costco Wholesale Corporation	38135.8333333333
283	Cardinal Health Inc.	37101.6666666667
31	Chevron Corporation	37051.3333333333
154	General Motors Company	35237.8333333333
10	JPMorgan Chase & Co.	34645.1666666667
163	Walgreens Boots Alliance Inc	34504.1666666667
15	Verizon Communications Inc.	33126
1	Microsoft Corporation	32634
73	Cigna Corporation	29887.1666666667
186	Kroger Co.	29733.8333333333
211	Marathon Petroleum Corporation	29302.3333333333
25	Bank of America Corp	28204.3333333333
151	Phillips 66	27696.5

Figure 2.6

ID	Company	Sales_revenue_Post_Covid
28	Walmart Inc.	135690.6666666667
3	Amazon.com Inc.	86836.3333333333
64	CVS Health Corporation	66384
11	UnitedHealth Group Incorporated	63891.3333333333
2	Apple Inc.	60898.6666666667
204	McKesson Corporation	58340.6666666667
301	AmerisourceBergen Corporation	47343.0613333333
39	Costco Wholesale Corporation	44619
22	Exxon Mobil Corporation	44278.6666666667
17	AT&T Inc.	42023
5	Alphabet Inc. Class A	41876.3333333333
6	Alphabet Inc. Class C	41876.3333333333
73	Cigna Corporation	39563
283	Cardinal Health Inc.	38303.6666666667
1	Microsoft Corporation	36736
163	Walgreens Boots Alliance Inc	35228
186	Kroger Co.	33920.3333333333
13	Home Depot Inc.	33283
10	JPMorgan Chase & Co.	33015.3333333333
15	Verizon Communications Inc.	31200
221	Ford Motor Company	30397.3333333333
76	Anthem Inc.	30014.3333333333
154	General Motors Company	28322.3333333333
140	Centene Corporation	27609
29	Comcast Corporation Class A	25285.3333333333

Figure 2.7

Sales revenue indicates the income from goods and services before deducting any expenses or incurred costs. To check the influence of the pandemic on companies' sales revenues, we retrieved data of the top 25 companies which are having the highest sales revenue before and after Covid (**Fig. 2.6 and 2.7**). From the results, we were able to analyse that there are some companies like Walmart Inc., Amazon.com Inc. etc. whose business has grown during the pandemic and their sales revenue has escalated. We have also done some further research (*Reference 2*) about the companies to get a better understanding of which type of industries got a boost during the pandemic. And we found that the business of retail companies like Walmart Inc. etc. and e-commerce companies like Amazon etc. has grown because of the increased demand due to uncertainty over the lockdown period where people stocked essential goods for their basic needs.

- Bottom 25 companies with lowest Sales revenue pre and post covid

ID	Company	Sales_revenue_Pre_Covid
255	MarketAxess Holdings Inc.	120.8731666666667
312	Paycom Software Inc.	170.2151666666667
384	ABIOMED Inc.	203.941
446	Federal Realty Investment Trust	233.4861666666667
449	Apartment Investment & Management Co Class A	234.3465
333	Duke Realty Corporation	246.0856666666667
360	UDR Inc.	281.0006666666667
430	Regency Centers Corporation	282.667833333333
462	Kimco Realty Corporation	287.6941666666667
357	Cboe Global Markets Inc	290.483333333333
219	VeriSign Inc.	307.4816666666667
484	SL Green Realty Corp.	310.596
353	Extra Space Storage Inc.	320.46
444	IPG Photonics Corporation	333.496333333333
142	DexCom Inc.	346.783333333333
287	Essex Property Trust Inc.	360.705
258	Realty Income Corporation	362.041333333333
257	Alexandria Real Estate Equities Inc.	368.930333333333
210	ANSYS Inc.	370.1236666666667
166	MSCI Inc. Class A	379.5696666666667
299	Jack Henry & Associates Inc.	401.635833333333
320	Mid-America Apartment Communities Inc.	406.0455
285	West Pharmaceutical Services Inc.	449.0166666666667
439	FLIR Systems Inc.	461.7311666666667
338	Healthpeak Properties Inc.	482.554

Figure 2.8

ID	Company	Sales_revenue_Post_Covid
255	MarketAxess Holdings Inc.	172.593
384	ABIOMED Inc.	193.757333333333
446	Federal Realty Investment Trust	205.327
312	Paycom Software Inc.	206.829
449	Apartment Investment & Management Co Class A	223.074
333	Duke Realty Corporation	242.3026666666667
430	Regency Centers Corporation	252.5166666666667
462	Kimco Realty Corporation	262.817333333333
442	Carnival Corporation	268.6666666666667
484	SL Green Realty Corp.	272.615333333333
444	IPG Photonics Corporation	288.031333333333
360	UDR Inc.	312.927
219	VeriSign Inc.	314.9226666666667
357	Cboe Global Markets Inc	315.733333333333
353	Extra Space Storage Inc.	334.2406666666667
415	Cabot Oil & Gas Corporation	336.615333333333
210	ANSYS Inc.	352.537
287	Essex Property Trust Inc.	377.8916666666667
448	Vornado Realty Trust	383.84
258	Realty Income Corporation	411.183
166	MSCI Inc. Class A	417.243
320	Mid-America Apartment Communities Inc.	418.1076666666667
486	Norwegian Cruise Line Holdings Ltd.	423.443
299	Jack Henry & Associates Inc.	430.581
410	Host Hotels & Resorts Inc.	451

Figure 2.9

Some companies like ABIOMED Inc., Federal Realty Investment Trust etc. (**Fig. 2.8 and 2.9**) had their sales revenue contracted post-pandemic. Due to the economic slowdown

during COVID-19, sales revenue of companies in real estate like Federal Realty Investment Trust were negatively impacted, as many tenants with no revenue stopped paying their rent.

- Effect on the Sales revenue of all Companies

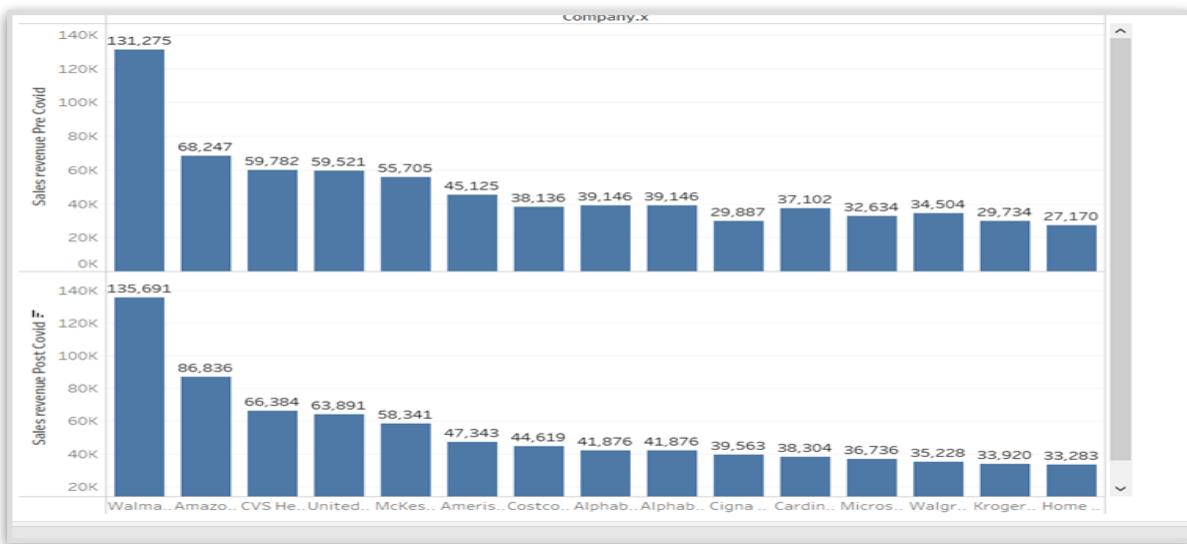
After analysing the data of the top 25 best and worst-performing companies in terms of sales revenue we analysed the data of all 494 companies and concluded that the sales revenue of 60% of the companies (294) has plunged. Sales revenue of companies is slightly less impacted as compared to their net income as there are 10% fewer negatively impacted companies.

ID	Company	Sales_revenue_Pre_Covid	Sales_revenue_Post_Covid	difference	effect
31	Chevron Corporation	37051.3333333333	23209.3333333333	13842	Negative
151	Phillips 66	27696.5	15906.6666666667	11789.8333333333	Negative
173	Valero Energy Corporation	26837.6666666667	15200.3333333333	11637.333333333401	Negative
211	Marathon Petroleum Corporation	29302.3333333333	19215.6666666667	10086.666666666599	Negative
140	Centene Corporation	17896.6666666667	27609	9712.3333333333	Positive
73	Cigna Corporation	29887.1666666667	39563	9675.8333333333	Positive
221	Ford Motor Company	39226.5	30397.3333333333	8829.1666666667	Negative
2	Apple Inc.	69148.8333333333	60898.6666666667	8250.166666666599	Negative
69	Boeing Company	21674.3333333333	14284.6666666667	7389.666666666599	Negative
318	Delta Air Lines Inc.	11617	4374	7243	Negative
472	American Airlines Group Inc.	11377.5	4436.6666666667	6940.8333333333	Negative
154	General Motors Company	35237.8333333333	28322.3333333333	6915.5	Negative
445	United Airlines Holdings Inc.	10792.1666666667	3981	6811.166666666701	Negative
64	CVS Health Corporation	59781.6666666667	66384	6602.33333333299	Positive
39	Costco Wholesale Corporation	38135.8333333333	44619	6483.166666666701	Positive
13	Home Depot Inc.	27169.6666666667	33283	6113.33333333299	Positive
134	L3Harris Technologies Inc	10182.1666666667	4511.3333333333	5670.83333333337	Negative
55	Lowe's Companies Inc.	17535	23095.3333333333	5560.333333333299	Positive
56	Wells Fargo & Company	25817.5	20394.3333333333	5423.166666666701	Negative
98	General Electric Company	24184.1666666667	19230	4954.166666666701	Negative
76	Anthem Inc.	25139.5	30014.3333333333	4874.833333333299	Positive
144	T-Mobile US Inc.	11213.6666666667	16018.6666666667	4805	Positive
442	Carnival Corporation	5011.6666666667	268.666666666667	4743.000000000003	Negative
28	Walmart Inc.	131275.1666666667	135690.6666666667	4415.5	Positive
11	UnitedHealth Group Incorporated	59521.3333333333	63891.3333333333	4370	Positive
186	Kroger Co.	29733.8333333333	33920.3333333333	4186.5	Positive

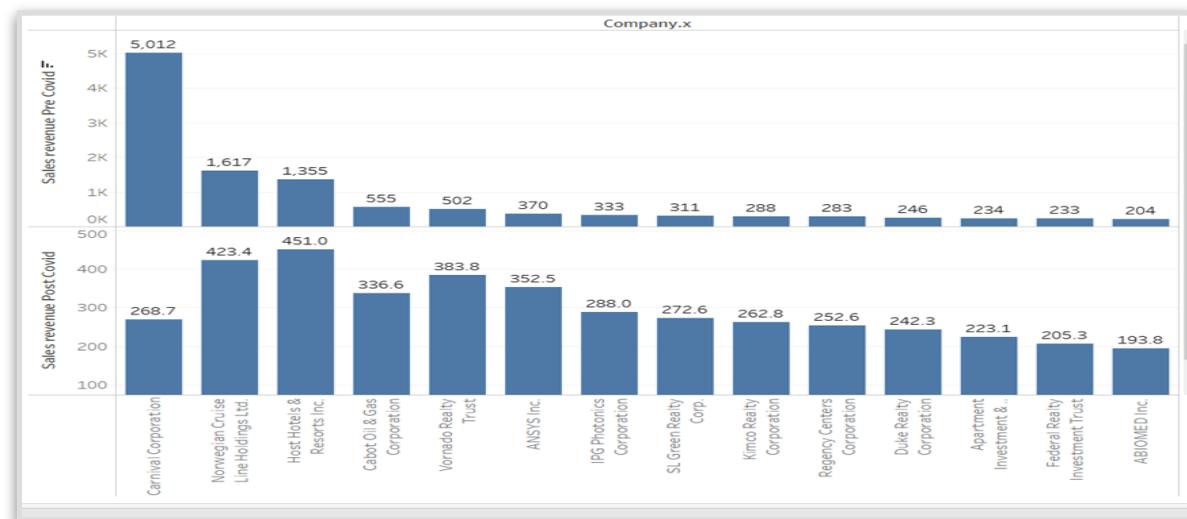
Figure 2.10

In **Fig. 2.10**, we can see the negative and positive impact on the sales revenue of all the companies. We also visualised the impact on companies before and post covid using plots (Plot-3 and Plot-4).

Companies having a positive effect on their Sales Revenue (Plot-3)



Companies having a negative effect on their Sales Revenue (Plot-4)



From the above plots, we can clearly see that the sales revenue of Walmart, Amazon etc. has been increased during the pandemic due to high demand in those sectors. On the contrary, sales of companies like Host Hotels & Line Holdings ltd.- a real estate company, Carnival corporations, the world's largest travel leisure company, are negatively impacted by the COVID-19 due to sudden containment. (Reference 3)

In terms of Market Capitalization:

- Top 25 companies with the highest market value pre and post covid

ID	Company	HistoricalMarketCap_Pre_Covid
1	Microsoft Corporation	974719.658333333
2	Apple Inc.	971227.496066667
3	Amazon.com Inc.	884669.376666667
5	Alphabet Inc. Class A	815280.7388
6	Alphabet Inc. Class C	815280.7388
4	Facebook Inc. Class A	494521.066666667
10	JPMorgan Chase & Co.	363321.889033333
7	Johnson & Johnson	361802.1919
8	Visa Inc. Class A	336313.06
22	Exxon Mobil Corporation	318196.911666667
28	Walmart Inc.	300567.591666667
25	Bank of America Corp	273275.6604
9	Procter & Gamble Com...	265259.3927
14	Mastercard Incorporated	251639.070333333
17	AT&T Inc.	247043.7104
11	UnitedHealth Group Inc...	241090.17
15	Verizon Communicatio...	239551.260283333
19	Pfizer Inc.	233066.52245
13	Home Depot Inc.	231191.901666667
31	Chevron Corporation	227100.012033333
12	Intel Corporation	226344.96
56	Wells Fargo & Company	220610.2848
21	Cisco Systems Inc.	214639.298333333
30	Coca-Cola Company	214319.66
18	Walt Disney Company	212116.57

Figure 2.11

ID	Company	HistoricalMarketCap_Post_Covid
2	Apple Inc.	1497434.946
1	Microsoft Corporation	1442909.74333333
3	Amazon.com Inc.	1307715.546666667
5	Alphabet Inc. Class A	918003.496866667
6	Alphabet Inc. Class C	918003.496866667
4	Facebook Inc. Class A	623037.1
28	Walmart Inc.	367916.816666667
8	Visa Inc. Class A	359031.34
7	Johnson & Johnson	356791.572766667
9	Procter & Gamble Company	304487.8544
14	Mastercard Incorporated C...	292188.176666667
10	JPMorgan Chase & Co.	284810.552166667
11	UnitedHealth Group Incorp...	270745.03
13	Home Depot Inc.	269276.173333333
16	NVIDIA Corporation	255397.566666667
15	Verizon Communications Inc.	232213.545633333
12	Intel Corporation	223645.4
24	Adobe Inc.	220594.562
17	AT&T Inc.	208744.5223
20	Merck & Co. Inc.	199873.927633333
25	Bank of America Corp	199536.2051
23	Netflix Inc.	195576.015733333
18	Walt Disney Company	194752.35
30	Coca-Cola Company	193436.376666667
19	Pfizer Inc.	183278.936666667

Figure 2.12

Market value is the company's worth based on the total value of its outstanding shares in the market, which is its market capitalization. The outbreak of the COVID-19 pandemic triggered a freefall in share prices of most of the companies. To analyse this, we compared data of the top 25 companies (Fig. 2.11 & 2.12) with the highest market share before and after the pandemic. Some top companies like Microsoft Corporation, Facebook, Alphabet Inc. etc. were able to maintain their market share even during the pandemic because of their products and services that are trusted by many people and highly efficient plan to adapt to the covid outbreak. (*Reference 4*) Whereas few companies like Johnson and Johnson, Amazon etc. are able to increase their market share due to the increase in demand of their products.

- Top 25 companies with the lowest market value pre and post covid

ID	Company	HitoricalMarketCap_Pre_Covid
478	H&R Block Inc.	5053.18965
454	Quanta Services Inc.	5195.83365
470	Leggett & Platt Incorporated	5507.97366666667
476	Hanesbrands Inc.	5763.22303333333
474	Harley-Davidson Inc.	5882.02786666667
373	Ingersoll Rand Inc.	5940.11503333333
481	Flowserve Corporation	6251.15965
456	People's United Financial Inc.	6275.55078333333
491	Nordstrom Inc.	6340.67783333333
463	Sealed Air Corporation	6346.29298333333
436	Assurant Inc.	6755.10415
480	Xerox Holdings Corporation	6766.3149
483	Unum Group	6851.64196666667
477	L Brands Inc.	6914.15666666667
437	Pentair plc	6996.00366666667
439	FLIR Systems Inc.	7035.18083333333
420	Perrigo Co. Plc	7071.2715
484	SL Green Realty Corp.	7169.62573333333
443	Robert Half International Inc.	7249.56603333333
449	Apartment Investment & Ma...	7280.50708333333
396	Fortune Brands Home & Se...	7355.10995
444	IPG Photonics Corporation	7578.314
467	News Corporation Class A	7671.58756666667
493	News Corporation Class B	7671.58756666667
453	Newell Brands Inc	7736.48666666667

Figure 2.13

ID	Company	HitoricalMarketCap_Post_Covid
490	Alliance Data Systems Corporation	1918.80333333333
491	Nordstrom Inc.	2277.163
485	TechnipFMC Plc	2976.82266666667
487	Kohl's Corporation	3053.08666666667
478	H&R Block Inc.	3055.84743333333
494	Coty Inc. Class A	3141.661
474	Harley-Davidson Inc.	3233.78243333333
483	Unum Group	3284.66576666667
465	Apache Corporation	3415.95593333333
484	SL Green Realty Corp.	3438.988
481	Flowserve Corporation	3451.40553333333
461	Devon Energy Corporation	3537.64333333333
459	Marathon Oil Corporation	3556.09666666667
479	PVH Corp.	3592.13583333333
480	Xerox Holdings Corporation	3717.9387
486	Norwegian Cruise Line Holdings...	3759.61156666667
471	Tapestry Inc.	3948.375
466	HollyFrontier Corporation	3962.84893333333
476	Hanesbrands Inc.	3964.46983333333
469	DXC Technology Co.	4012.78666666667
464	National Oilwell Varco Inc.	4030.06603333333
473	Alaska Air Group Inc.	4167.62503333333
470	Leggett & Platt Incorporated	4545.04466666667
492	Under Armour Inc. Class A	4562.58863333333
456	People's United Financial Inc.	4616.96073333333

Figure 2.14

Companies from different sectors like automobiles, travel & tourism, hospitality are unfortunately impacted the most. In fig. 2.13 & 2.14, we can see that the market share of Harley-Davidson Inc., Flowserve Corporation etc. has been disdained. To get the better insight on the broader level we checked and visualized market share data of all the companies. (Fig.2.15)

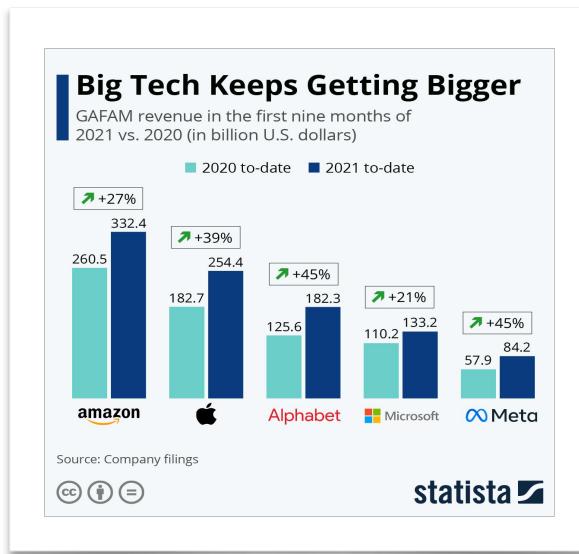
- Effect on the total market value of all the companies

ID	Company	HitoricalMarketCap_Pre_Co...	HitoricalMarketCap_Post_Co...	difference	effect
3	Amazon.com Inc.	884669.376666667	1307715.546666667	423046.17000000284	Positive
22	Exxon Mobil Corporation	318196.911666667	164920.186666667	153276.7249999998	Negative
16	NVIDIA Corporation	121329.981666667	255397.566666667	134067.5850000002	Positive
4	Facebook Inc. Class A	494521.066666667	623037.1	128516.03333333298	Positive
56	Wells Fargo & Company	220610.2848	106727.715866667	113882.568933333	Negative
69	Boeing Company	201983.02785	93637.2924666667	108345.73538333332	Negative
5	Alphabet Inc. Class A	815280.7388	918003.496866667	102722.7580666669	Positive
6	Alphabet Inc. Class C	815280.7388	918003.496866667	102722.7580666669	Positive
31	Chevron Corporation	227100.012033333	145448.289966667	81651.722066666	Negative
24	Adobe Inc.	140585.10575	220594.562	80009.45625000002	Positive
10	JPMorgan Chase & Co.	363321.889033333	284810.552166667	78511.33686666598	Negative
25	Bank of America Corp	273275.6604	199536.2051	73739.4553	Negative
28	Walmart Inc.	300567.591666667	367916.816666667	67349.2249999998	Positive
27	PayPal Holdings Inc	117852.525	182531.323333333	64678.79833333302	Positive
54	Citigroup Inc.	153382.846133333	94607.4437	58775.40243333299	Negative
145	DuPont de Nemours Inc.	91053.7370666667	34907.9858333333	56145.751233333394	Negative
23	Netflix Inc.	142665.431116667	195576.015733333	52910.58461666602	Positive
144	T-Mobile US Inc.	61766.151733333	114325.450633333	52559.2988999997	Positive
19	Pfizer Inc.	233066.52245	183278.936666667	49787.58578333294	Negative
34	salesforce.com inc.	130982.3375	178270.543333333	47288.20583333299	Positive
43	NIKE Inc. Class B	133830.236666667	180282.663333333	46452.426666666	Positive
14	Mastercard Incorporate...	251639.070333333	292188.176666667	40549.106333334	Positive
9	Procter & Gamble Com...	265259.3927	304487.8544	39228.46169999995	Positive
17	AT&T Inc.	247043.7104	208744.5223	38299.1881	Negative
13	Home Depot Inc.	231191.901666667	269276.173333333	38084.271666666	Positive
35	Bristol-Myers Squibb C...	93933.025	131643.406666667	37710.381666667	Positive
201	Schlumberger NV	58757.665	21969.65333333333	36788.011666667	Negative
84	Advanced Micro Devic...	32564.5583333333	69061.5633333333	36497.00499999999	Positive

Figure 2.15

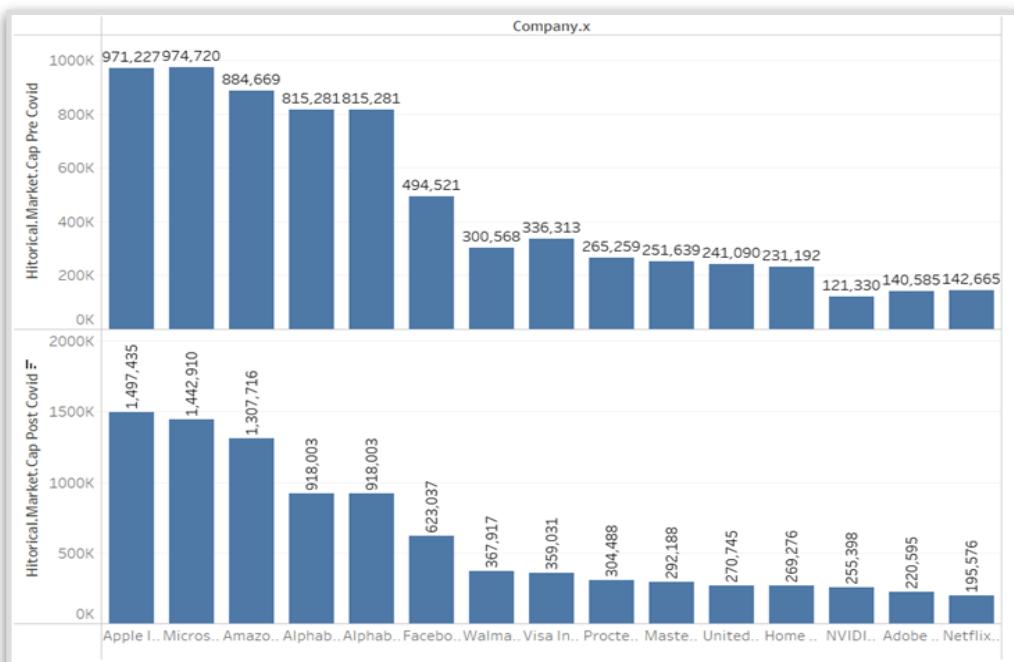
Due to covid, several companies had to suspend their supply chains or temporarily close brick-and-mortar impacted the market capitalization of the companies. As per our research on our available dataset we analysed that the market capitalization of about 295 companies (approx. 60%) has been crashed.

From Plot-5, we examined that some of the top companies like Apple, Microsoft, Amazon, Walmart etc. were increased their market share by introducing the latest technology or making better strategies to cope up with the pandemic situation. (*Reference 5*)

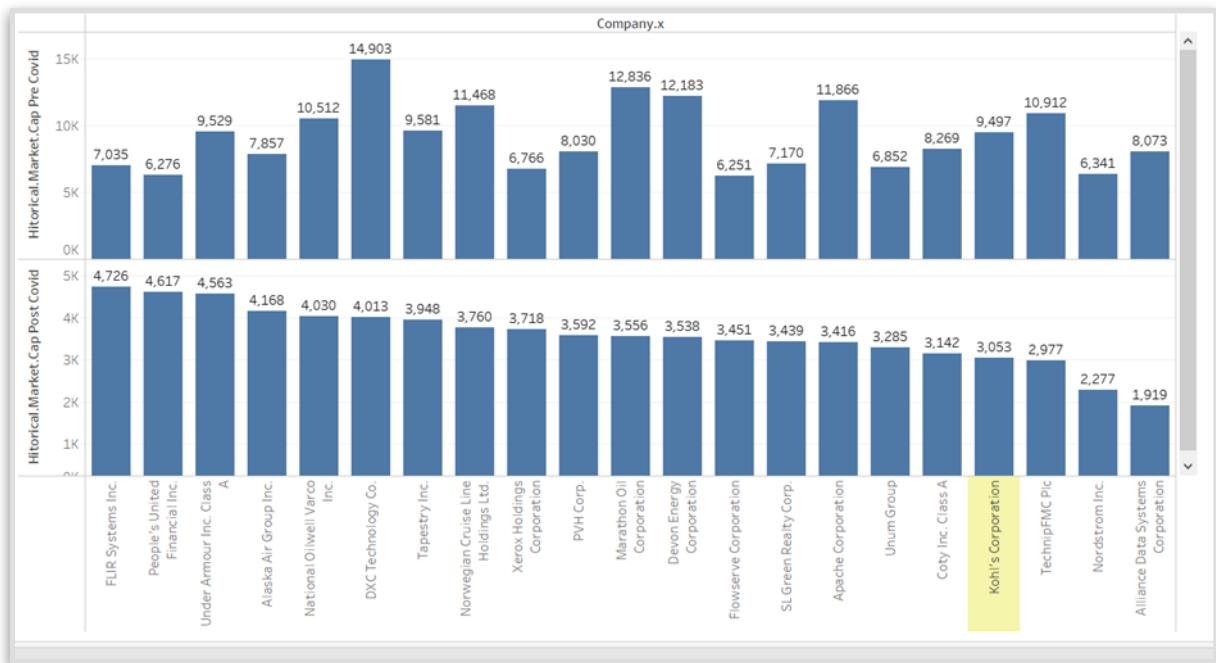


Florian Zandit (Oct 21, 2020)

Companies with positive effect on market share post covid (Plot-5)



Companies with negative effect on market share post covid (Plot-6)



As per Plot-6, there are approximately 295 companies whose market share has dropped post covid. Market share of companies like FLIR Systems Inc. which is a thermal imaging camera and sensors industry has dipped from 7.035 to 4.726. Though the demand for thermal detector during COVID has increased but still for some companies it is difficult to face the fierce competition in this sector which results in reduction of their market share.

Results

COVID-19 has had a detrimental effect on companies' ROA, Sales Revenue and market value with most companies showing an abysmal performance. Nearly 70% of companies have seen their ROA drop after the pandemic, whereas the remaining 30% were able to maintain or increase their return on assets. The corporations' performances based on their return on assets changed dramatically as there was a complete update and shuffle to the list of the top 25 companies ranked according to their ROA financial indicator. Five

companies slipped straight out of the list after the pandemic, but the remaining were still displayed as the top 25 best-performing companies but had a reshuffling process. Of the list of the 25 companies with the lowest ROA, only two corporations (National Oilwell Vanco Inc. and TechnipFMC Plc) remain on the list, indicating most of these companies were able to leverage the pandemic to their benefit and enhance or increase their performances and drive their return on assets upwards. However, the ROA values show a significant exponential decline which confirms that COVID-19 has had a negative impact on the ROA of those companies.

Comparing the change in sales revenue before and after COVID-19 shows that retail revenue is rising because people still need to stock up on essential items given the uncertainty of the pandemic and the chance of lockdowns at any time. Nevertheless, the fate of real estate companies is disastrous, as they are the worst performers in terms of sales revenue. Also, the revenue figures for travel companies were not very good, probably due to the awareness of protection against the virus and the restrictions imposed by governments. Nevertheless, the overall positive post-epidemic rise in sales revenue was not as pronounced as the pre-epidemic rise.

For the world's top companies, their market share has even increased rather than decreased in the aftermath of the outbreak. However, the blow to the smaller companies is huge, with their market share being cut in half or even lower straight away.

Conclusions

Covid-19 did not hit the retail industry of daily necessities and e-commerce too hard, as consumers still need to buy on an ongoing basis. Moreover, in exceptional cases, consumers may even overspend and stock up on large quantities of ingredients to guard against an outbreak or a potential lockdown. However, Covid-19 has a significant negative impact on the real estate industry. In the face of the unavoidable, the top companies have their own strong Public Relations (PR), and they can combat most of the fluctuations in the market unlike the smaller companies who do not have a considerable financial base or an extended market manipulation experience to survive an epidemic where uncertainty prevails. They have had to defend themselves by laying off staff and closing shops to keep their companies afloat.

Due to the restrictions imposed and control measures, there will be limited supply chain transportation capacity, increased product procurement costs and insufficient production supply. The synergistic integration of supply systems will help economic recovery across all sectors.

We know that data visualization allows complex analysis results to be presented to the reader as rich and simple graphical information, transforming the analysed data into business insights, and providing effective support for decision-makers. Data visualisation also makes it easier for analysts to clearly understand the relationships between variables and how they change.

Business Recommendations

After our explanatory analysis, results and conclusions we give out a few recommendations to these businesses to perform better under any uncertain conditions related to the Covid-19 outbreak now and in the future.

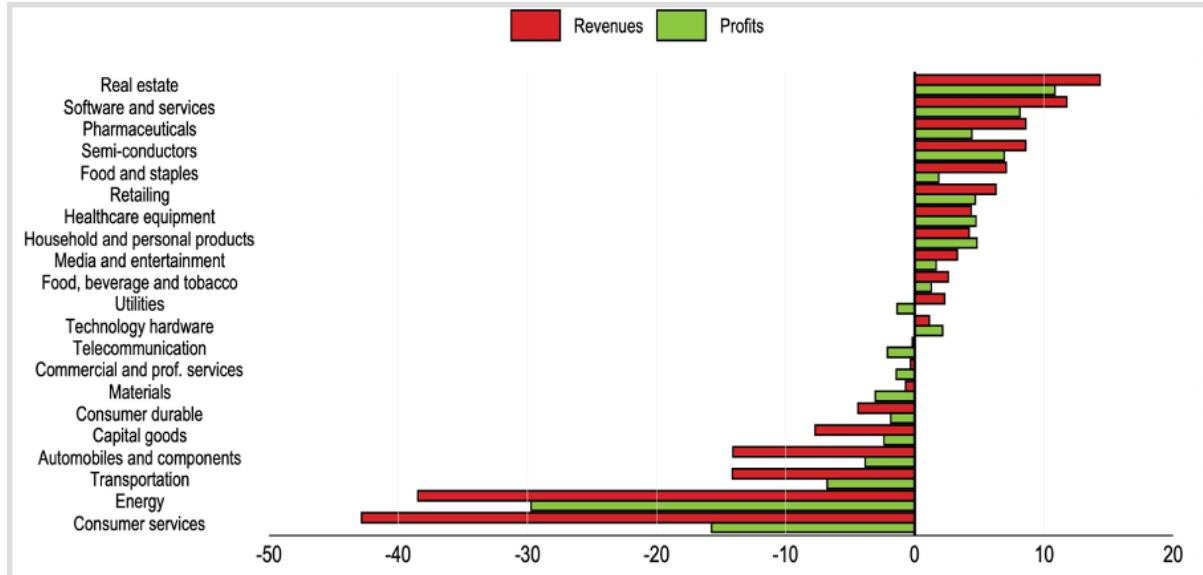
1. With the limited availability of financial data for supply chain sectors of corporations, companies need to consider various indicators in a comprehensive manner with enough data available unlike the current data set we explored with hundreds of missing values.
2. Companies need to develop more contingency plans to resist problems caused by unavoidable factors and properly prepare for PLAN B in case of any uncertain circumstances that might occur.
3. Companies in the real estate industry should focus on rapid improvement plans to increase their return on assets and revenues after a huge drop in the following financial indicators since the outbreak of Covid-19.
4. Companies should be adaptable to the uncertainties in the industry or in the business world and work as per the current demand to make their place in the market competition and retain their market value.

References

1. Puy, D. P., & Rawdanowicz, L. R. (2021, June 22). *Covid-19 and the corporate sector: Where we stand*. VOX, CEPR Policy Portal. <https://voxeu.org/article/covid-19-and-corporate-sector-where-we-stand>
2. Molly Kinder and Laura Stateler Tuesday, (December 22, 2020). *Amazon and Walmart have ranked in billions in additional profits during the pandemic*.
<https://www.brookings.edu/blog/the-avenue/2020/12/22/amazon-and-walmart-have-ranked-in-billions-in-additional-profits-during-the-pandemic-and-shared-almost-none-of-it-with-their-workers/>
3. Trinity Business School, Trinity Research in Social Sciences. *Online event “Travel and Tourism in a Post Covid Society”*
<https://www.tcd.ie/business/news-events/travel-tourism-impact-covid19.php>
4. The Irish Times (2021, Nov 29). *Pandemic pays for big tech as Alphabet, Apple and Microsoft beat high expectations*
<https://wwwirishtimes.com/business/technology/pandemic-pays-for-big-tech-as-alphabet-apple-and-microsoft-beat-high-expectations-1.4632149>
5. Florian Zandit (2021, Oct 21). *Big Tech Keeps Getting Bigger*
<https://www.statista.com/chart/21584/gafam-revenue-growth/>

Appendices

Appendix A



Appendix B

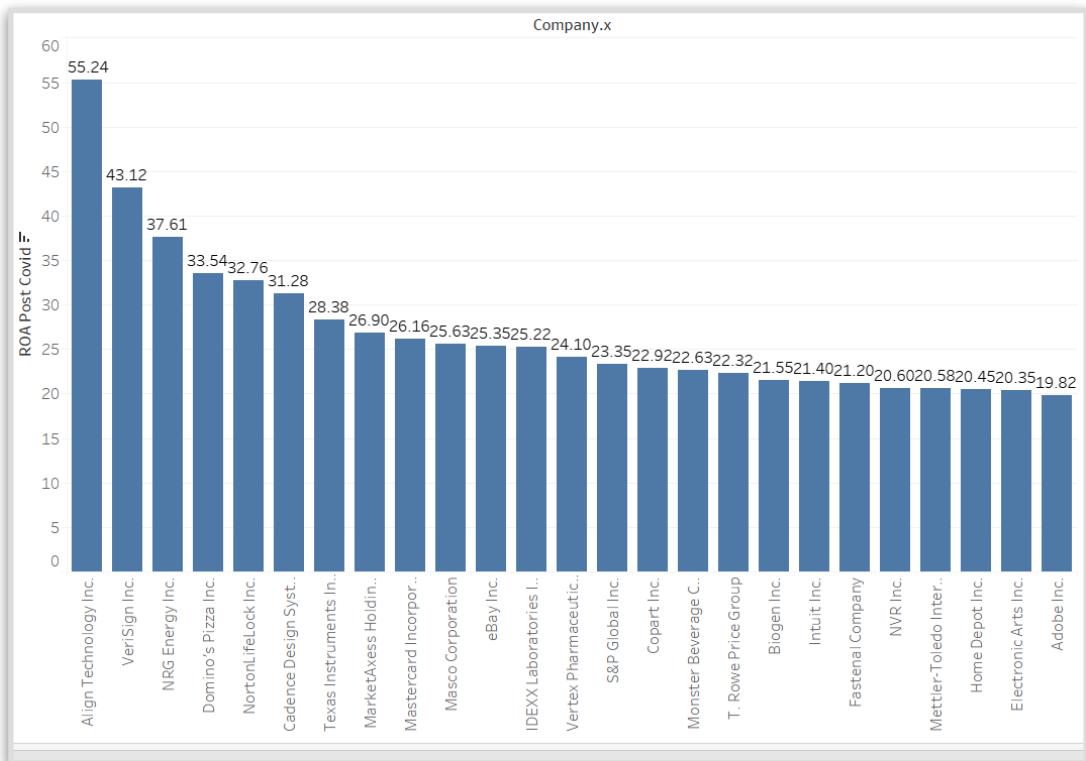
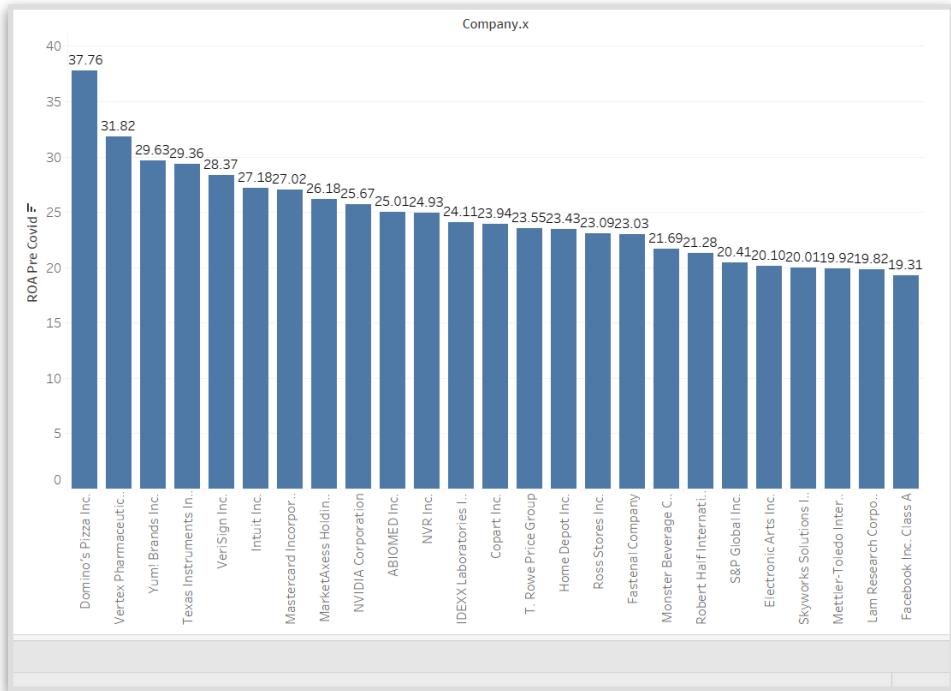
Company.x	Equity.x	NUM_OF_EMPLOYEES	Country_Count	ROA_Pre_Covid	ROA_Post_Covid	Hitorical.Market
1 Microsoft Corporation	MSFT US EQUITY	144000	6	13.3764333	16.10236667	
2 Apple Inc.	AAPL US EQUITY	137000	5	15.9666167	17.62620000	
3 Amazon.com Inc.	AMZN US EQUITY	798000	9	6.9405000	6.12433333	
4 Facebook Inc. Class A	FB US EQUITY	44942	6	19.3123333	17.96673333	
5 Alphabet Inc. Class A	GOOGL US EQUITY	118899	6	12.9321333	12.59593333	
6 Alphabet Inc. Class C	GOOG US EQUITY	118899	6	12.9321333	12.59593333	
7 Johnson & Johnson	JNJ US EQUITY	132200	6	8.2953500	10.45210000	
8 Visa Inc. Class A	V US EQUITY	0	4	16.2781667	15.84123333	
9 Procter & Gamble Company	PG US EQUITY	97000	4	6.1797333	8.97380000	
10 JPMorgan Chase & Co.	JPM US EQUITY	256981	5	1.2663667	0.90693333	
11 UnitedHealth Group Incorporated	UNH US EQUITY	325000	3	8.2645500	8.84570000	
12 Intel Corporation	INTC US EQUITY	110800	7	15.1082000	16.28006667	
13 Home Depot Inc.	HD US EQUITY	415700	6	23.4325000	20.45443333	
14 Mastercard Incorporated Class A	MA US EQUITY	18600	4	27.0180833	26.15520000	
15 Verizon Communications Inc.	VZ US EQUITY	135000	6	7.1274000	6.43140000	
16 NVIDIA Corporation	NVDA US EQUITY	9823	7	25.6731167	17.56046667	
17 AT&T Inc.	T US EQUITY	247800	4	3.9012167	2.28916667	
18 Walt Disney Company	DIS US EQUITY	223000	4	9.1885167	0.19430000	
19 Pfizer Inc.	PFE US EQUITY	88000	10	9.2232000	7.75566667	
20 Merck & Co. Inc	MRK US EQUITY	71000	9	9.1630833	12.48140000	

Appendix C MySQL Query (Reference of MySQL code file)

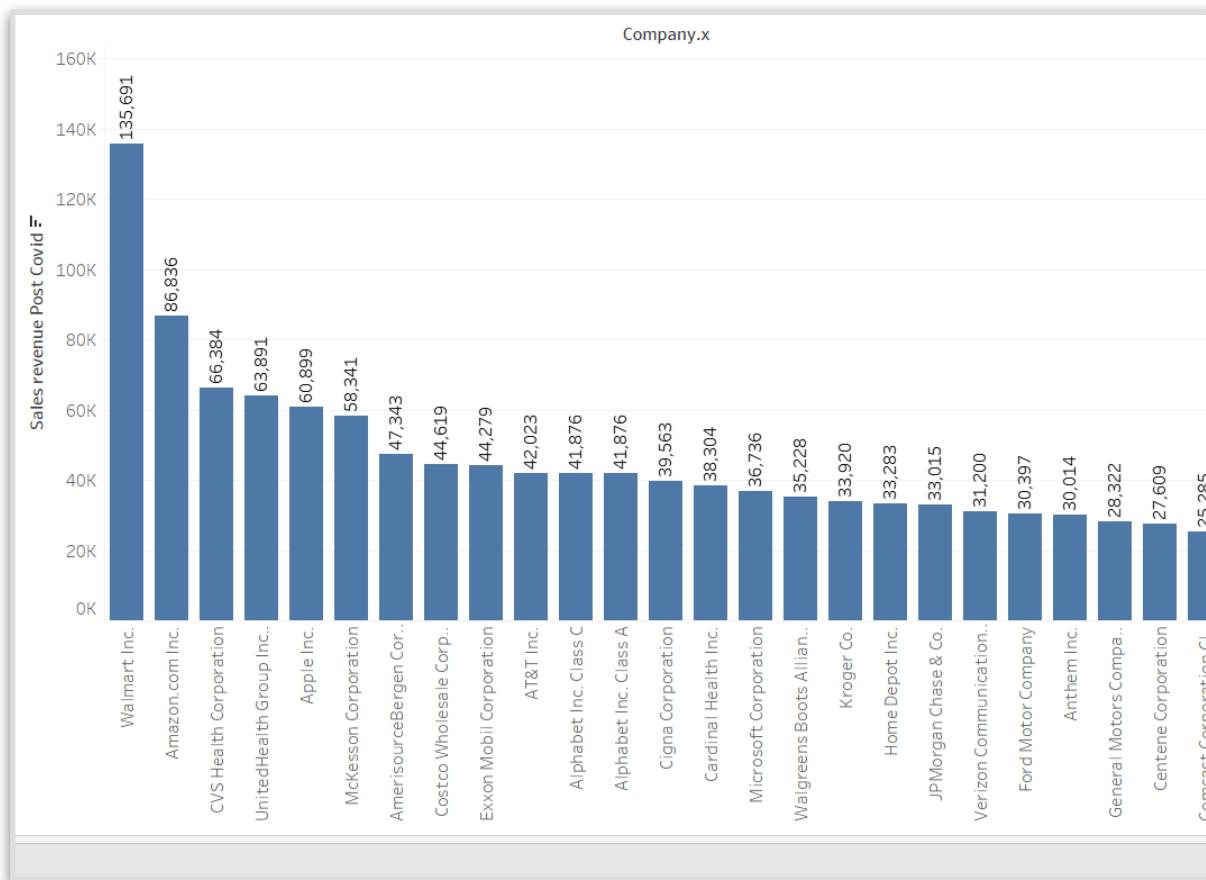
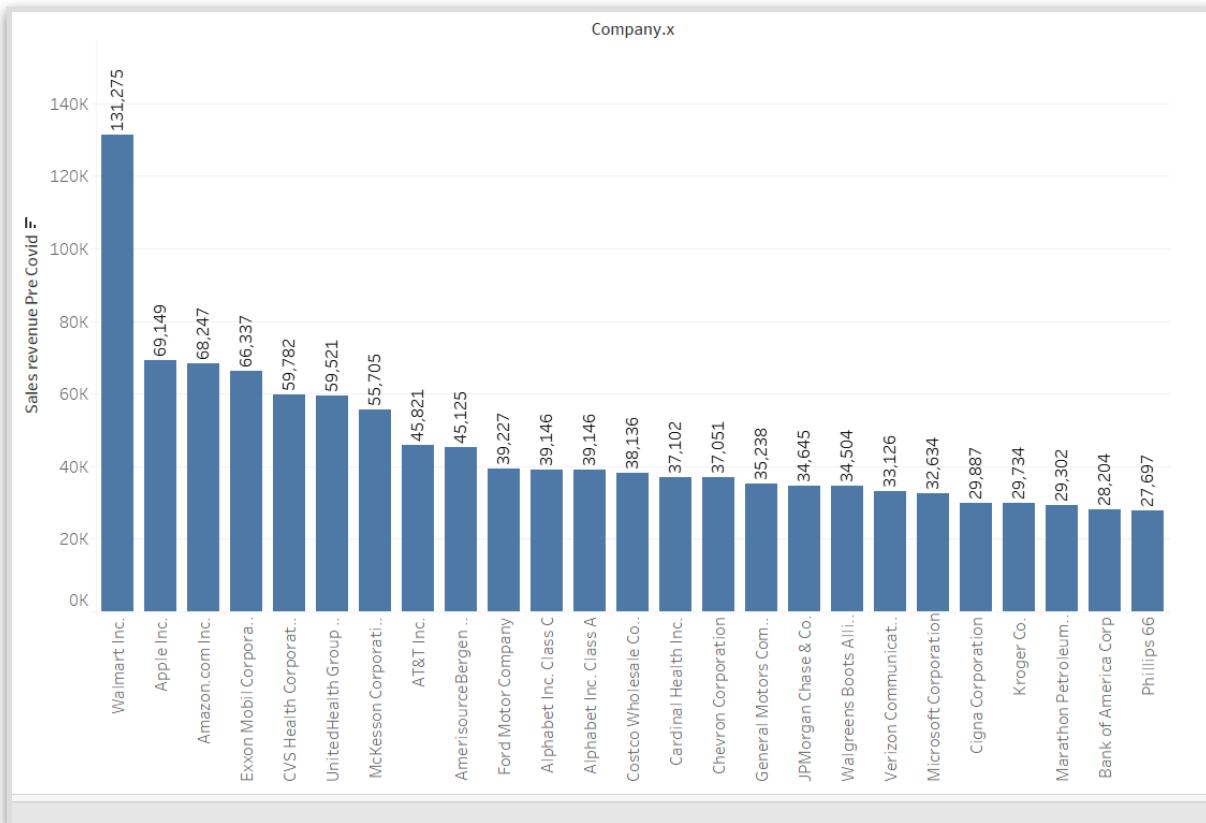
Appendix D

Plots for visualisation

- **Top 25 companies with the highest ROA pre and post covid**



- Top 25 Companies with the Highest Sales revenue pre and post covid



- Top 25 companies with the highest market value pre and post covid

