Exploratory Data Analysis

Data Analytics Bootcamp - Project 1

**Sector Performance During and Immediately After a Recession.**

**Chart

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1 - INTRODUCTION

**Aim:**

The aim of this project is to analyse historical stock market data and attempt to draw insights relating the ways sectors within the S&P500 behave during, and immediately after, a recession. We will try to use those insights to predict future market behaviour. In addition we will seek to determine the factors which impact the length of a sector’s recovery, post recession.

**S&P 500:**

The S&P 500 is a group comprising the largest 500 publicly listed companies based on market capitalisation.

The S&P 500 is widely regarded as one of the best indicators of large company performance and of the performance of the stock market more broadly.

**S&P 500: Sectors**

The companies listed on the S&P 500 can be categorised using the following eleven sectors:

|  |  |  |  |
| --- | --- | --- | --- |
| 1. Energy | (2) Material | (3) Industrials | (4) Consumer (Discretionary) |
| (5) Consumer (Staples) | (6) Health Care | (7) Financial | (8) Technology |
| (9) Communications | (10) Utilities | (11) Real Estate |  |

2 - DATA ACQUISITION

Our stock price data and sector performance data was obtained through Yahoo Finance.

## 

**Data Fields and Variables:**

**yfinance**: A python package that downloads market data from the Yahoo! Finance's API.

**yf.download()**: A function which can download the market data based on the selected time period.

With the adjustment of the start and end dates below, we were able to send a request to the Yahoo Finance website and acquire the data we needed for the relevant timeframe.

Scatter chart

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2 - DATA ACQUISITION (continued)

Once downloaded, the SECTOR data that the yfinance package provides includes:

|  |  |
| --- | --- |
| **Fields** | General field information. |
| **Date** | The date for this record. |
| **Open** | The opening price on that date. |
| **High** | The highest price on that date. |
| **Low** | The lowest price on that data. |
| **Close** | The closing date on that date. |
| **Adj Close** | Amended stock closing price after any corporate actions. |
| **Volume** | Traded volume on that date. |

Once downloaded, the INDIVIDUAL COMPANY data that the yfinance package provides includes:

|  |  |
| --- | --- |
| **Fields** | General field information. |
| **Symbol** | ID for the stock. |
| **Shortname** | Name of the stock. |
| **Longname** | Name of the stock. |
| **Sector** | Sector the stock belongs to. |
| **Industry** | Industry the stock belongs to. |
| **Currentprice** | The latest price of the stock. |
| **Marketcap** | The combined value of all shares for the company. |
| **Ebitda** | Earnings before interest, taxes, depreciation, and amortisation. |
| **Revenuegrowth** | The amount of money the company makes over a pre-determined time period compared to the previous, identical amount of time. |
| **City** | The register city of the stock. |
| **State** | The state of the stock. |
| **Country** | The city of the stock. |
| **Fulltimeemployees** | Number of full-time employees |
| **Longbusinesssummary** | Business summary of the company. |
| **Weight** | The percentage value of each stock in the **portfolio.** |

3 – IMPORTANT DEFINITIONS and BASELINE ASSUMPTIONS

During a recession the total market index will decrease.

History tells us that the market will **ALWAYS** recover from a recession. We know this because it hit a record high in January 2022.

In addition, we know that **ALL** sectors recover from a recession, albeit at different rates. This can be seen in the figure below showing the market ‘bounce-back’ after the most recent recession brought about by COVID 19:

Chart, scatter chart

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Chart, scatter chart

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Chart, line chart

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Later in the report, we will feature a deeper dive into the post COVID-19 recession recovery.

3 – DEFINITIONS and ASSUMPTIONS (continued)

For the purposes of this project, please use the following definitions:

|  |  |
| --- | --- |
| **Daily Return:** | A metric for analysing index performance.  It represents the daily change in price as a percentage of the opening price. |
| **Moving Average:** | A [technical analysis](https://www.investopedia.com/terms/t/technicalanalysis.asp) tool that smooths out price data (removing the sudden undulations). It does so by creating a constantly updated [average price](https://www.investopedia.com/terms/a/averageprice.asp).  The average is taken over a pre-defined period, like days, minutes, weeks.  The time period can be updated to suit the needs of the analyst. |
| **Daily Trade Volume:** | The total number of a particular share that are traded on a given day. |
| **Bull market:** | The conditional of a financial market in which prices are rising or are expected to rise. |
| **Bear market:** | A bear market is characterised by falls of 20% or more from a 52 week high. A bear market is generally marked by investor pessimism which can cause prices to continue falling, adding to further negative sentiment. |
| **Quotient of Recovery (QRec):** | This quotient is a metric which has been designed by the group. It is a measure of how long recovery takes relative to the length of the recession. It allows for the comparison of sector recoveries after recessions of DIFFERENT LENGTHS. |

**Calculating the Quotient of Recovery:**

**Using the Quotient of Recovery:**

QRec = 1.5 - Means the recover took 1.5 times longer than the length of the recession.

QRec = 0.75 - Means the recover took 75% of the length of the recession.

**Why use a Quotient of Recovery instead of ‘days’?**

Recovery can indeed be measured in days, and when comparing sector performance after a particular recession it serves us well. The problem we encounter, however, is when we wish to compare sector performances across multiple different recessions. Our group feels that a recovery will likely take longer if the recession, itself, was longer. Thus, having a measure such as QRec, which takes into account the recession length, was seen by the team as beneficial when attempting to compare recovery data for the sectors over time.

3 – DEFINITIONS and ASSUMPTIONS (continued)

**A demonstration of how you might identify the quantities needed to calculate a QRec value.**

|  |  |  |  |
| --- | --- | --- | --- |
| (1) | Chart, line chart  Description automatically generated | (2) | Chart  Description automatically generated |
| (3) | Chart  Description automatically generated | (4) | Chart  Description automatically generated |
| (5) | Chart  Description automatically generated | (6) | Chart  Description automatically generated |
| (7) | Chart  Description automatically generated | (8) | Chart  Description automatically generated |

4 – CLEANING THE DATA

The data retrieved from Yahoo finance does not need to be cleaned. All values of interest are present.

There is no missing data in either the “Sector” or “Marketcap”, CSV files.

5 – RECESSIONS IN FOCUS

Throughout this project the group will perform an exploratory data analysis (EDA) focusing on the first 3 recession periods in the table below.

All 6 recessions in the table will be used in the final section of the project where we seek to find a correlation between the ‘GDP decrease’ observed during a recession and the time since the last recession.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Name** | **Start** | **End** | **Duration**  **(Months)** | **Last Recession**  **(Months)** | **Unemployment**  **(Peak)** | **GDP decline**  **(Peak)** |
| **COVID 19** | Feb 2020 | April 2020 | 2 | 128 | 14.7% | −19.2% |
| **Global Financial Crisis** | Dec 2007 | June 2009 | 18 | 73 | 10.0% | −5.1% |
| **Dot Com**  **(9-11 attack)** | Mar 2001 | Nov 2001 | 8 | 120 | 6.3% | −0.3% |
| **Early 1990s** | July 1990 | Mar 1991 | 8 | 92 | 7.8% | −1.4% |
| **Early 1980s**  **(Part 1)** | July 1981 | Nov 1982 | 16 | 12 | 10.8% | −2.7% |
| **Early 1980s**  **(Part 2)** | Jan 1980 | July 1980 | 6 | 58 | 7.8% | −2.2% |

Source: Wikipedia

6 – OUR KEY QUESTIONS

|  |  |
| --- | --- |
| 1 | Do all sectors take the same amount of time to recover after a recession? |
| 2 | Is there a link between the number of days a recession lasts for and the number of days it takes for the market and its eleven sectors to recover? |
| 3 | Do sectors that experience higher percentage losses during a recession take longer to recover? |
| 4 | Has the market recovered after the Covid 19 recession? |
| 5 | Is the market on a bull or bear trend? |
| 6 | Is it still a good time to invest in the stock market? |
| 7 | Can we tell the trend from the cause of a recession? |
| 8 | What makes a sector perform differently to the others? |
| 14 | Is there a correlation between sectors? |
| 9 | Can the previous price help to make a judgments around the decision to buy or sell? |
| 10 | How is GDP affected during a recession? |
| 12 | Is there a correlation between GDP decline and unemployment rates during a recession? |
| 13 | During a recession, is there a correlation between GDP decline and the time since the last recession? |
| 14 | Is there a link between GDP growth and stock market performance? |

7 – QREC ANALYSIS - COVID-19 RECESSION

(Feb 2020 – April 2020)

**Data frame showing recovery information for market and sectors:**

Table

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**Bar charts showing sector QRecs during COVID 19 Recession:**

|  |  |
| --- | --- |
| Chart  Description automatically generated | Chart, line chart  Description automatically generated |

7 – QREC ANALYSIS - COVID-19 RECESSION (continued)

(Feb 2020 – April 2020)

**Insights:**

* All sectors were negatively impacted by the recession, but the severity of that impact varied. This is demonstrated by the fact that all sectors took at least *some* time to recover and consequently have a blue bar on the charts above. The size of each blue bars indicates the duration of the recovery.
* The market took 1.11 times the length of the recession to recover.
* Real Estate, Utilities, Financial, Industrial, Consumer (Discretionary) and Energy all took considerably longer than the market average to recover.
* Materials, Consumer Discretionary, Health Care, Technology and Communications took considerably less time than the market average to recover despite all taking a hit of some degree.
* The slowest recovery was Utilities which took 8.25 times the length of the recession to recover. Energy wasn’t too far behind, taking 6.74 times the length of the recession to recover.
* The fastest sector to recover was Health Care. It only took approximately 26% of the recession duration to recover.

8 – QREC ANALYSIS - GFC RECESSION

(Dec 2007 – June 2009)

**Data frame showing recovery information for market and sectors:**

Table, Excel

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**Bar charts showing sector QRecs during GFC Recession:**

|  |  |
| --- | --- |
| Chart  Description automatically generated | Chart  Description automatically generated |

8 – QREC ANALYSIS - GFC RECESSION (continued)

(Dec 2007 – June 2009)

**Insights:**

* All sectors were negatively impacted by the recession, but again the severity of that impact varied. As compared to the COVID-19 recession, each sector took a greater amount of time to recover relative to the length of the recession. The fastest sector to recover after this recession was Consumer (Discretionary). It took 58% of the recession length to bound back to pre-recession levels. In the COVID recession the fastest recovery time belonged to the Health Care sector at 26% of *its* recession length. Consumer Staples was the second fastest to recover with a QRec of 1.03.
* The market took 2.42 times the length of the recession to recover.
* The variation in recovery times across the sectors is less for the GFC than it was during the COVID-19 recession. The range in QRecs is 4.6 as compared to 8. Sectors had a more similarity negative experience throughout the GFC.
* Except for Consumer (Discretionary), all sectors took longer than the duration of the recession to recover.
* Only Financial and Utilities underperformed by way of recovery as compared to the market average. All others matched or outperformed the market average.

9 – QREC ANALYSIS – DOT-COM RECESSION

(March 2001 – November 2001)

**Data frame showing recovery information for market and sectors:**

Table

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**Bar charts showing sector QRecs during DOT-COM Recession:**

|  |  |
| --- | --- |
|  |  |

9 – QREC ANALYSIS – DOT-COM RECESSION (continued)

(March 2001 – November 2001)

**Insights:**

* The Materials sector took only 6 days to recover its losses from this recession. Its QRec score of 0.02 suggests it recovers in 2% of the time the recession lasted.
* The market took 5.55 times the length of the recession to recover. This Market QRec score is the highest of the 3 recessions analysed, by some distance. (GFC: 2.42 and COVID-19: 1.11)
* 5 of the 10 sectors were nearly unaffected by this recession, with Communications, Technology Utilities, Health Care and Industrials taking the brunt of the downturn.
* The Communications sector recorded a QRec score of 27.93, meaning that it took 6872 days to recover. Relative to other sectors in the same recession, no sector has taken a bigger hit. The second highest QRec score for the Dot-Com recession belonged to Technology at 8.45. This score represents only 30% of the Communications QRec score.

In the GFC the second highest QRec score was 63% of the highest.

In the COVID 19 recession the second highest QRec score was 82% of the highest.

*Please note that the Real Estate sector data is not available for the Dot-Com recession or any other recession prior.*

10 – QREC ANALYSIS – ALL 3 Recessions (continued)

**QRec scores for each sector in all three recessions:**

Chart, bar chart, box and whisker chart

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**Average QRec scores for each sector across all three recessions:**

Chart

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**Insights:**

* As we can throughout the past three recessions, Consumer related sectors recovered at the fastest rate, followed by the Materials sector. That means a recession has the capacity to bolster the strength of these two sectors relative to the other nine.
* The Communications sector has been the slowest to recover in the past three recessions, primarily due to being hit so hard, relative to the rest of the market, throughout the Dot-Com recession. It might also be explained by the fact that consumers prioritise the purchase of food and essential services during recessions and spend less of their income on products and services supplied by other sectors.

10 – QREC ANALYSIS – ALL 3 Recessions (continued)

**Sector Loss Versus Recovery Time:**

In this section of the report we will investigate the possibility that there exists a relationship between the amount of money lost by a sector and it’s recovery time.

Below is a data frame that was constructed to facilitate the process:

Table

Description automatically generated

**The following scatter plots depict:**

1. The recovery time in days for each sector versus the percentage of that sector’s value that was lost throughout its recession.

(Each dot represents a sector in particular recession.)

1. The recovery quotient versus the percentage of that sector’s value that was lost throughout its recession.

(Again, each dot represents a sector in particular recession.)

10 – QREC ANALYSIS – ALL 3 Recessions (continued)

|  |  |
| --- | --- |
|  |  |

**Insights:**

* Both scatter plots show a weak to non-existent relationship between the depth of the loss for each sector and its recovery time.

That is to say, a more substantial loss for a given sector does not predict with any certainty a longer recovery time. This is supported by the respective r-squared values of 0.007 and 0.016 for the two linear regression models shown above.

* The fact that sector ‘bounce back’ appears unrelated to the size of that sector’s loss has meant that historically, large losses have be recovered quite quickly by certain sectors, while other sectors have taken relatively large amounts of time to recover small losses.

**Answers to key questions:**

**Do all sectors take the same amount of time to recover after a recession?**

Certainly not according to stock market data from the last three recessions. There is an enormous amount of variation in terms of sector recovery time after a particular recession.

An extreme example of this involves the recoveries of the Communications and Materials sectors post the Dot-Com recession in the early 2000s. The former took 6872 days to recover (more than 27 times longer than the market as a whole), whilst the latter took only 6 days to recover (2% of the time the market, as a whole, took to recover).

**Is there a link between the number of days a recession lasts for and the number of days it takes for the market and its eleven sectors to recover?**

One might think that a longer recession would mean a longer recovery, but this has not been the case for the last three recessions.

* The COVID-19 recession lasted 61 days and took the market 68 days to recover (QRec = 1.11).
* The Dot-Com recession lasted 246 days and took the market 1365 days to recover (QRec = 5.54).

Those believing a pattern to exist would then assume that the GFC recession, which lasted a staggering 549 days would have required a recovery time well in excess of the 1365 days taken by the Dot-Com crash.

It only required a recovery time of 1327 days (QRec = 2.417).

In summary, this analysis shows that recovery time is not solely dependent on the recession length.

10 – QREC ANALYSIS – ALL 3 Recessions (continued)

**Do sectors that experience higher percentage losses during a recession take longer to recover?**

The two scatterplots above indicate that there is no relationship between the loss in value incurred by a sector and the time it takes to recover.

For the scatterplot of each sector’s Recovery Time (days) versus Percentage Price Drop the line of best fit did little to suggest that an increase in Price Drop would result in an increase in Recovery Time. It was nearly horizontal in appearance and the linear regression model returned an r-squared value of 0.007. This signifies an extremely weak to non-existent relationship between the two variables.

Similarly, the scatterplot of each sector’s QRec versus Percentage Price Drop did little to suggest that an change in Price Drop would impact Recovery Time. It, too, was nearly horizontal in appearance and the linear regression model returned an r-squared value of 0.016.

**Limitations:**

The data for Real Estate only exist for the COVID-19 recession and the Global Financial Crisis.

We were unable to acquire data to perform an analysis of the recession that occurred prior to the year 2000.

11 – Post COVID-19 Recession (A deep dive)

As discussed in section 3 of this report, the market and all eleven of its sectors have recovered from the COVID-19 recession. Each has hit record heights in terms of price in recent months.

We will now investigate this ‘bounce-back’ in greater detail. The following charts are based on stock market data from the end of the recession until 27/3/2022.

|  |  |
| --- | --- |
| **Adjusted S&P500 Close Price since the end of the COVID-19 recession:**  Chart, line chart  Description automatically generated | **Revenue Growth by Sector since the end of the COVID-19 recession:**  Chart, pie chart  Description automatically generated |
| **Weight by Sector since the end of the COVID-19 recession: Date (27/3/2022)**  Chart, pie chart  Description automatically generated | **Weight by State since the end of the COVID-19 recession: Date (27/3/2022)**  Chart, pie chart  Description automatically generated |

11 – Post COVID-19 Recession (A deep dive) (continued)

**Insights:**

* We can see from the Adjusted S&P500 Close Pricechart above that the S&P 500 market has increased in overall value by more than 90%.
* All sectors have experienced positive growth, led by Consumer (discretionary) with 34.28% growth since the end of the recession. It is likely that Tesla has contributed significantly to that result, growing a whopping 12% in the 9 days leading up to the 27th of March, 2022.
* Consumer (discretionary) is a sector classified as providing non-essential goods and services. Consumers tend to spend more on Consumer (discretionary) products in economic growth phases, when individuals have more disposable income.
* The Technology sector makes up almost a quarter (23.68%) of the S&P 500 total weighting.
* The largest U.S. companies, based on Market Capital, are Apple, Microsoft, Alphabet, Amazon and Facebook. They currently account for 17.5% of the S&P 500. That means that anyone who invests in the SPDR S&P 500 ETF is simultaneously investing heavily, and perhaps unknowingly, in these companies too.
* There is risk associated with investing in Technology. Tech companies face unique threats from regulators in the U.S. and Europe, who heavily scrutinize them looking for [anti-competitive practices](https://www.cnbc.com/2019/06/10/congressional-hearing-takes-on-antitrust-behavior-among-digital-giants.html).
* California has the biggest share of market capital. This can easily be explained and many of the world largest companies by market cap have headquarters in CA. ( e.g. APPLE, ALPHABET, TESLA, META, VISA, etc.)

* California is home to a very unique and diverse population. Perhaps nowhere else on Earth do you have such high concentrations of (bio)tech workers, entertainment industry leaders, agricultural innovators and other niche skill sets. That is why many big companies choose California as their bases.
* The first figure above shows that the stock market is in a bull run after Covid-19 Pandemic. It keeps climbing despite real-world turmoil (i.e. The US Presential election in Nov 2020, the capitol insurrection in Jan 2021, the 500,000 US Covid deaths early March 2021)

There are some straightforward financial reasons why the market has continued to flourish. The Federal Reserve took extraordinary measures to support financial markets and reassure investors it wouldn’t let major corporations fall apart. Congress did its part as well, pumping trillions of dollars into the economy across multiple relief bills. Turns out giving people money is good for markets, too. Tech stocks, which make up a significant portion of the S&P 500, soared. And with bond yields so low, investors didn’t really have a more lucrative place to put their money.

* Another notable point we can see from the charts is that the market has gone up a lot, in record time. Since end of Covid recession, the S&P 500 has surged more than 90%. That’s the highest first-year bull market gains since 1945 and outpaced the average of 37.5% for all prior bull markets.

The speed of this bull market makes sense when one looks at how quickly the bear market of 2020 occurred: 33 days from peak to trough. Thats the fastest on record. And then the market recovered everything it had lost in fewer than five months, the third-shortest period in market history to recoup such a massive level of losses.

Historically, bull markets that return more quickly are an indication that investors had less uncertainty and more conviction in an economic and earnings recovery.

11 – Post COVID-19 Recession (A deep dive) (continued)

* Note that there was a recent dip in in the stock market, in Jan 2022.

Pundits believe this was due to investor nervousness surrounding the Federal Reserve’s upcoming interest-rate decision. There was a swift turnaround in the market’s fortunes in March 2022.

* Despite the constant uptrend, S&P 500 still hasn’t risen back above its 200-day moving average. This indicates market participants still aren’t fully comfortable buying stocks at prices consistent with their longer-term trends. Perhaps the reason is because Russia’s invasion of Ukraine is affecting confidence.

**Answers:**

**Has the market recovered after the Covid 19 recession?**

Last March, stocks plunged as the world faced the frightening spread of the Covid virus. Surprisingly, the market quickly rebound and the S&P500 is up more than 90% since the Covid recession.

**Is the market in a bull or bear trend?**

A new bear market begins when an index or other security falls 20% or more away from its peak or trough. Likewise, we have enters a bull market when prices rise 20% or more from a bottom.

In an overall trend for the past 12 months, the stock market is obviously in a bull run.

However, there's no perfect way to label a bull or bear market. It's easier to focus on specific time frames or to consider the sequence of peaks and valleys on the price chart. Plus, with what is going on around the world at the moment, it is hard to predict whether the bull run will continue.

**Is it still a good time to invest in the stock market? (Answers are at the end)**

If you are a long term investor, then yes.

If you're looking to invest for your future -10, 20, or 40 years off , then now is always as good a time as ever to buy stocks. Waiting for a pullback in stocks with a long-term view isn't going to make that much difference. How much is a 10% difference going to make on your buy price today in 40 years when your original investment has grown more than 10-fold?

And if you invest consistently over time, putting more cash into your investments every month or so you'll end up catching a correction or a stock market crash on occasion.

Also, the overall uptrend from the charts supported this.

Warren Buffett once said, "I make no attempt to forecast the market. My efforts are devoted to finding undervalued securities." For him, whatever the market is doing doesn't matter.

12 – GDP/Economy Vs Stock Market during recessions.

1. Recession period comparison



Chart, bar chart

Description automatically generated

The 1990s were the longest period of economic growth in American history up to that point. The collapse of the speculative dot-com bubble, a fall in business outlays and investments, and the September 11th attacks, brought the decade of growth to an end.

12 – GDP/Economy Vs Stock Market during recessions.

1. How the economy reacted to the recession from 1980 to 2020

GDP and unemployment declined. Covid 19 lasted only two months, but it hit the worst.

The rates of GDP and unemployment were the highest

Chart, waterfall chart

Description automatically generated

12 – GDP/Economy Vs Stock Market during recessions.

1. The relationship between the economy and share market

Diagram

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The graph below shows it is a negative relationship between GDP declined and Time since last recession.

Chart, scatter chart

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**Insights:**

* Several studies (Dimson et al. [2002], Ritter [2005]) found that the correlation between stock returns and GDP can be negative
* The graph “ GDP Growth and S&P 500 Returns 1980 – 2020, GDP was quite stable. In comparison, we can see S&P\_500 had dramatic fluctuations. The highest point and lowest point were 29.30 and -39.20%

12 – GDP/Economy Vs Stock Market during recessions.

Chart

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Chart, scatter chart

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**Insights:**

* The graph above showed that there was no correlation between GDP and S&P 500 companies

**Conclusion:**

It is concluded that GDP usually has a negative trend whenever there is an economy recession and high unemployment rate. In contrast, share return still performs well although it has fluctuations.

**Limitation:**

It cannot predict the future share price because of the world volatility and ongoing Ukraine war.

13 – Closing Price & Cause

**13.1 The performance of each sector varies, some sectors gain, and some lose.**

International events can lead to market recessions. Because of the different nature of events, the market will behave differently during a recession.

Some sectors related to the causes of the recession may have the biggest losses and become disaster areas. (e.g., the financial sector experienced the largest losses in 2008 GFC).

And some may be affected less during the recession. (e.g., the health sector in covid, has the least loss).

Furthermore, people's predictions about the future will also affect the current market.

* **COVID-19 – Feb 20 to Apr 20**

Graphical user interface

Description automatically generated with medium confidenceChart

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All sectors fell, the energy sector fell the most, and the health sector fell the least.

The recession is caused by a global pandemic.

* **The financial crisis (GFC) – Dec 07 to Jun 09**

Graphical user interface

Description automatically generated with low confidenceChart

Description automatically generated

All sectors fell, the financial sector fell the most, and the health fell the least.

The financial crisis was primarily caused by deregulation in the financial industry.

* **Dot-Com bubble – Mar 01 to Nov 01**

Graphical user interface, chart

Description automatically generated Chart, waterfall chart

Description automatically generated

All sectors fell, Utilities fell the most, and Materials fell the least. No information on Real Estate backs that time. We think the most fell of Tech and the least fell is Materials makes sense. But we are not sure what happened on the Utilities. Why the price dropped greater than the tech sector?

13 – Closing Price & Cause (continued)

**13.2 The causes of a recession can help predict the trend of the market.**

Based on the causes of the recession, people can predict a little bit sector’s performance regarding the cause of the recession.

**13.3 Limitation**

However, the cause is often discovered after the market has crashed due to the long tail effect of the market. Therefore, the judgment only based on the cause will not make a big difference.

14 – Closing Price vs. Volume

**14.1 Trade volume reflects market confidence and will affect the price.**

Volume measures the number of shares traded in a sector. Volume can indicate market strength. From the plot we generated, we found that “Daily Trade Volume" and "Daily Retune" seem to have similar patterns through observation.

* **COVID-19 – Feb 20 to Apr 20**

Background pattern

Description automatically generated with medium confidence A picture containing text

Description automatically generated

* **The financial crisis (GFC) – Dec 07 to Jun 09**

Timeline

Description automatically generated Diagram

Description automatically generated

* **Dot-Com bubble – Mar 01 to Nov 01**

Calendar

Description automatically generated

There is no daily trade volume data during the Dot-Com bubble.

14 – Closing Price vs. Volume (continued)

**14.2 There is a pattern between Daily Return and Daily Volume**

The peaks and deeps on Return & Volume always seem to appear in pairs.

The turning point of volume (the direction change of acceleration) often indicates the turning point of return.

* **COVID-19 – Feb 20 to Apr 20**

Chart

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14 – Closing Price vs. Volume (continued)

* **The financial crisis (GFC) – Dec 07 to Jun 09**

**Chart

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* **Dot-Com bubble – Mar 01 to Nov 01**

There is no daily trade volume data during the Dot-Com bubble.

**14.3 Daily Return and Daily Volume can help predict the trend of the market.**

Daily Return and Daily Volume are closely related due to their definitions. The daily trading volume affects the price, and the daily return is obtained by the price. Mathematically speaking, there is a correlation between these two.

From a market perspective, trading volume can help investors identify market trends.

If the volume keeps moving on one way, the price usually does not change its direction. In other words, if the volume trend remains unchanged (continuously increasing or decreasing), the price trend does not change. At this point, it is safe to keep the strategy you have.

If the volume trend changes, from increasing to decreasing (or a decrease becomes an increase), which means that the price is facing a reversal point. At this point, you may need to consider changing your strategy.

14 – Closing Price vs. Volume (continued)

**14.4 Limitation**

However, in theory, the above statement is correct. But in the real world, this theory might not work due to various reasons. For example, volume changes every second, and we can only know the change of trend after it crosses the extreme value. Therefore, the relationship between Volume and Return is not enough to help investors make a clear judgment. But there is indeed a close correlation between them, and volume can reflect investors' confidence and interest in the market.

15 – Moving Average

**15.1 The moving average (MA) can help smooths out price data and help the judgment.**

As can be seen from the plot below, the daily closing price moves up and down around the average line and make crossovers. The different average lines also crossed.

The moving averages can help to identify trend direction and to determine support and resistance levels.

The short-term average is trending closer to price.

* **COVID-19 – Feb 20 to Apr 20**

Diagram

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15 – Moving Average (continued)

* **The financial crisis (GFC) – Dec 07 to Jun 09**

Chart, map

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* **Dot-Com bubble – Mar 01 to Nov 01**

*No real estate price data during the Dot-Com period. The plot of this sector is blank*

Chart

Description automatically generated

**15.2 The moving average (MA) can help predict the trend**

Crossovers are one of the main moving average strategies.

First, we can judge by the crossover on the closing price and the moving average line. When the price crosses above or below a moving average, there will be a signal for change in trend.

Chart, map

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15 – Moving Average (continued)

Second, we can judge by the crossover on the short-term and long-term moving average lines. When the shorter-term MA crosses above the longer-term MA, it's a buy signal, as it indicates that the trend is shifting up. This is known as a golden cross. Meanwhile, when the shorter-term MA crosses below the longer-term MA, it's a sell signal, as it indicates that the trend is shifting down.

Chart, line chart

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**15.3 Limitation**

Moving averages are calculated based on historical data and nothing about the calculation is predictive in the real world. if the price becomes choppy, the price may swing back and forth, generating multiple trend reversals or trade signals. When this occurs, we need another indicator to help clarify the trend.

If prices start fluctuating, sometimes the market won't respect MA support/resistance trade signals. Moving averages work well in strong trending conditions but poorly in ranging conditions.

16 – Correlation Heatmaps

The correlations between the various industries are getting tighter over time. The colour of the plot is getting warmer.

The colour of the heat map is getting warmer means that all industries are getting closer than ever due to the Cross-Industry. Thus, during the recession, no matter which sector you invest in, it will be affected strongly by others.

* **COVID-19 – Feb 20 to Apr 20**

Chart

Description automatically generated

* **The financial crisis (GFC) – Dec 07 to Jun 09**

Chart

Description automatically generated

* **Dot-Com bubble – Mar 01 to Nov 01**

Chart

Description automatically generated

To understand it, let's use Apple as an example. If Apple sells strongly on its newly released products (iPhone, Mac Book, etc.), then all companies in its supply chain, such as mobile phone accessories manufacturers or retailers, will have a good business performance as well. Their stock price will go up, and their sector is different from Apple.

Therefore, when making investment decisions, the correlation between sectors should be a very important consideration. Regarding this topic, other data need to be introduced from different perspectives. We won’t be able to discuss it more deeply here.