# Key Insights

**(i) Stock trend**

Index is in uptrend and the stocks that are in:

1. Uptrend: Apple, Amazon, Google, Goldman Sachs, J&J, Merck & Co
2. No trend / sideways: Hawaiian Holdings
3. Downtrend: American Airlines, Alaska Air, Bausch Health, Credit Suisse, Deutsche Bank
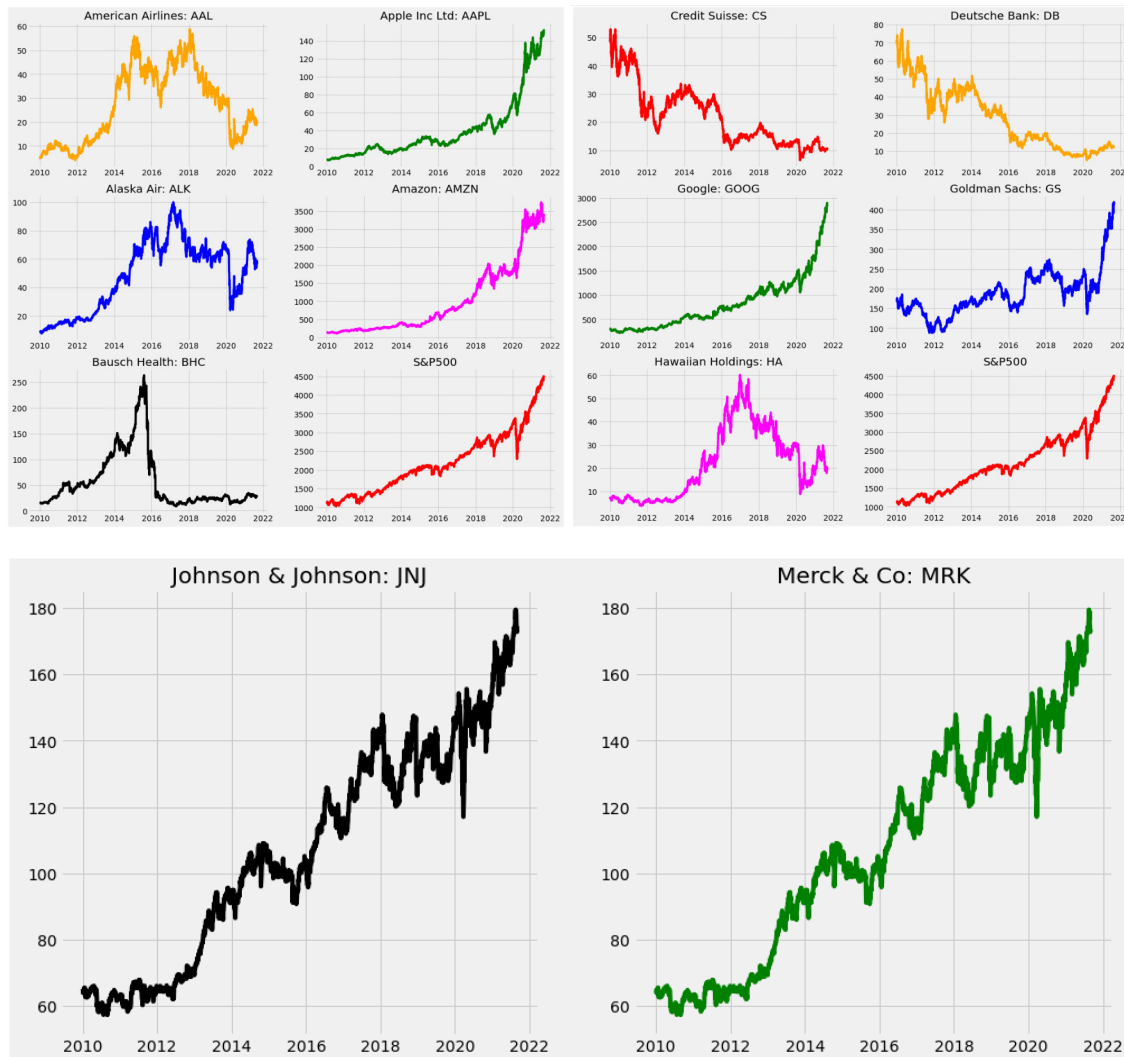




Stocks in down trend are to be avoided. We will only focus on stocks that are in an Uptrend.

**(ii) Correlation**

Index is in an uptrend and these stocks have the following correlation:

1. Strong Positive Correlation (0.6 to 1): Apple, Amazon, Google, Goldman Sachs, J&J, Merck & Co
2. Weak Positive Correlation (0 to 0.6): American Airlines, Alaska Air, Hawaiian Holdings

3. Negative Correlation (0 to -1): Bausch Health, Credit Suisse, Deutsche Bank
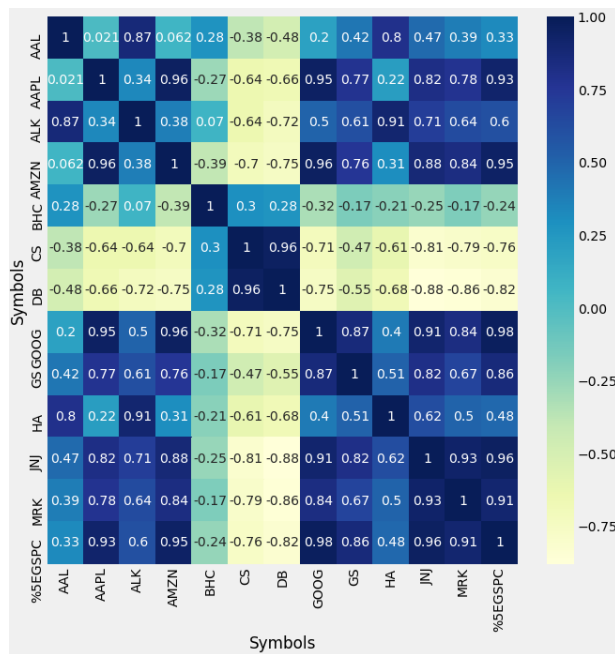


Stocks with positive correlation are recommended during the advancing phase of market cycle / index, whilst stocks with negative correlation should be avoid during this phase.

**(iii) Returns generated**

Considering index returns as average returns (mean: 0.000536), check how stocks have performed:

| | AALreturn | AAPLreturn | ALKreturn | AMZNreturn | BHCreturn | CSreturn | DBreturn | GOOGreturn | GSreturn | HAreturn | JNJreturn | MRKreturn | %5EGSPCreturn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| count | 2936.000000 | 2936.000000 | 2936.000000 | 2936.000000 | 2936.000000 | 2936.000000 | 2936.000000 | 2936.000000 | 2936.000000 | 2936.000000 | 2936.000000 | 2936.000000 | 2936.000000 |
| mean | 0.001028 | 0.001182 | 0.000940 | 0.001302 | 0.000867 | -0.000265 | -0.000238 | 0.000897 | 0.000475 | 0.000865 | 0.000394 | 0.000351 | 0.000536 |

1. Good positive returns: American Airlines, Apple Inc Ltd, Alaska Air, Amazon, Bausch Health, Google and Hawaiian Holdings
2. Below average returns: Goldman Sachs, Johnson & Johnson and Merck & Co
3. Poor returns (below 0.5): Credit Suisse and Deutsche Bank

Select stocks that have provided better returns that S&P500 index

## (iv) Volume Analysis
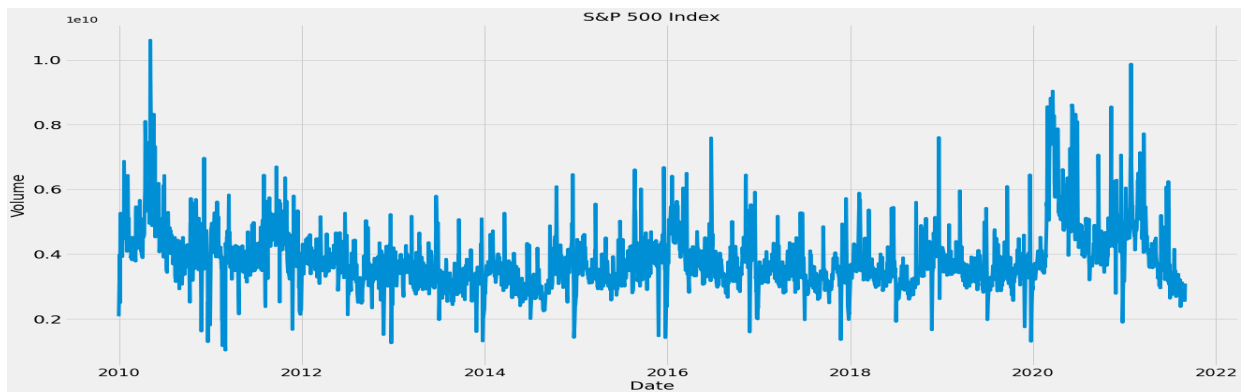


Peaks and troughs suggest that there are high and low volumes traded respectively on all these stocks on certain days. This may be due to several factors like State / National election result declaration, COVID lockdown announcements, annual financial budget, etc

## (v) Volatility
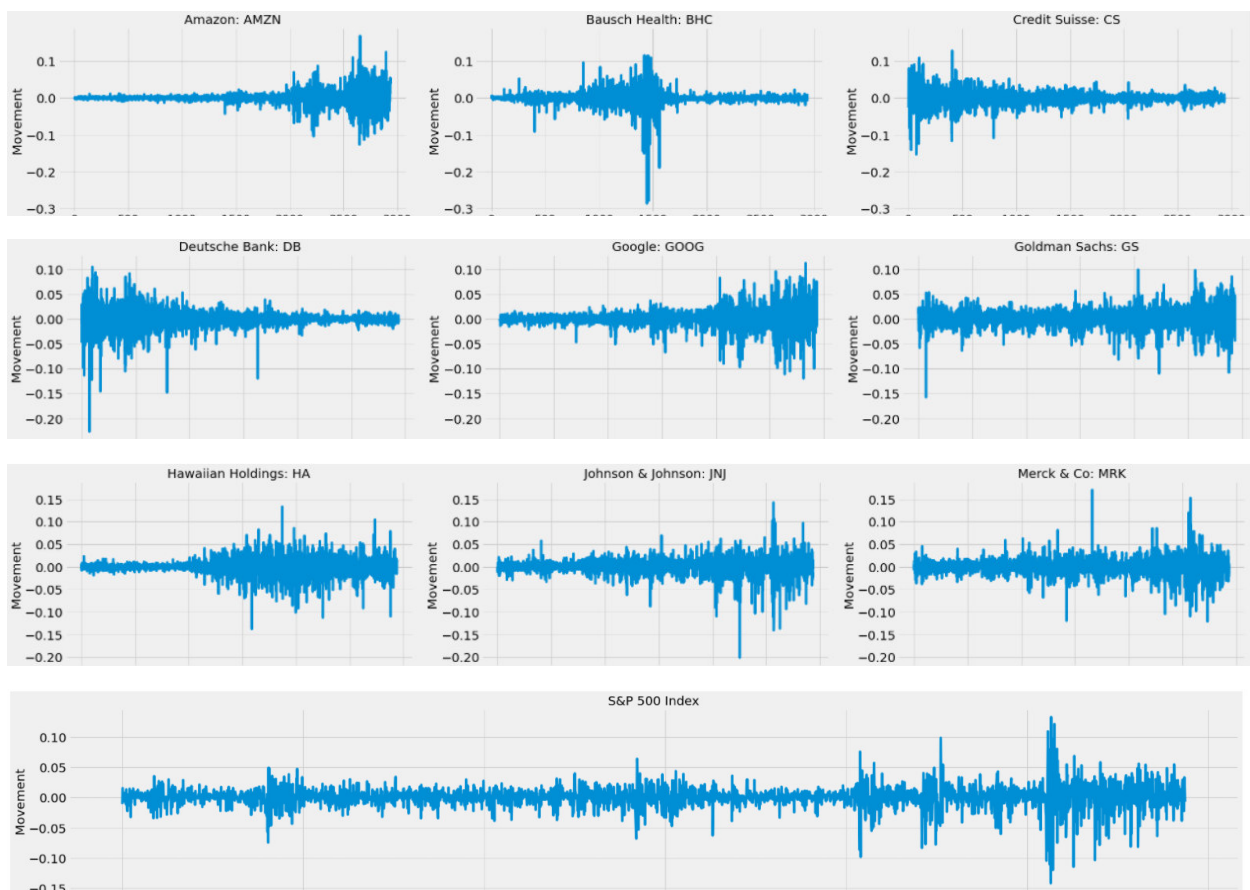


After normalization, we note that S&P500 in recent times (i.e 2020 and 2021) has been moving frequently (suggesting volatility increase). Also visible with stocks that have high correlation with index.

**(vi) k-means clustering and Principal Component Analysis (PCA)**

When we normalized the data and then performed k-means clustering (4 clusters), post PCA these stocks could be bucketed as below, based on their movements:

| Clusters | Companies |
|---|---|
| 0 | American Airlines, Alaska Air, Hawaiian Holdings |
| 1 | Bausch Health, Goldman Sachs, Johnson & Johnson, Merck & Co, S&P 500 Index |
| 2 | Credit Suisse, Deutsche Bank |
| 3 | Apple Inc Ltd, Amazon, Google |

**(vii) Sharpe Ratio Calculation**

Amazon, Apple Inc Ltd and Google have outperformed the index based on Sharpe ratio (sorted in descending order). It can be cross-checked with the k-means clustering under point (vi) - refer cluster 3.

| Stocks | Cumulative Return (%) | Standard Deviation (%) | Sharpe Ratio |
|---|---|---|---|
| Amazon | 2465 | 32 | 78 |
| Apple Inc Ltd | 1615 | 28 | 58 |
| Google | 429 | 26 | 16 |
| S&P 500 Index | 214 | 17 | 12 |
| Alaska Air | 351 | 38 | 9 |
| Johnson & Johnson | 138 | 17 | 8 |
| Merck & Co | 133 | 21 | 6 |
| American Airlines | 170 | 53 | 3 |
| Hawaiian Holdings | 92 | 48 | 2 |
| Goldman Sachs | 21 | 29 | 1 |
| Bausch Health | 19 | 56 | 0 |
| Deutsche Bank | -86 | 42 | -2 |
| Credit Suisse | -77 | 36 | -2 |

**(viii) Standard deviation**

Standard deviation depicts the risk inherent in the stock. The lower it is, lesser is the volatility. We can note that J&J has the lowest standard deviation of 17, which is also confirmed by the fact that it belongs to a defensive segment like Pharmaceutical. Hence, we will consider this stock as well (though the Sharpe ratio of J&J is 8, which is lower than the index of 12), post which we will run the Optimization Algorithm to see which of these 4 stocks (Amazon, Apple Inc Ltd, Google and J&J) make it to the final list.

**(ix) Conclusion**

After running the optimization algorithm, we note that if $1 Lac needs to be allocated on these 4 stocks in the investor's portfolio (as of 31st Aug 2021 close of business day), this would be allocated as follows:
  1. Amazon: 13 stocks
  2. Apple Inc Ltd: 342 stocks

3. Google: 1 stock
4. Johnson and Johnson: 0 stocks

There would still be $44.63 remaining with the investor after purchasing the above stocks.

We can see that out of 12 stocks from the original list, only 3 stocks bring optimum results to the investor, so a concentrated portfolio is recommended with 3 stocks for low risk and superior returns.