Analyzing FAANG Stock Trends and Insights

W200 project2, December 6, 2022

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Github Repository:

- https://github.com/UC-Berkeley-I-School/Project2_Cherry_Godinez

Primary Dataset:

- FAANG- Complete Stock Data | Kaggle

Primary Data Structure:

- **Date**: We can analyze various trends/statistics **over different periods of time** using this variable.
- **Open**: Price of stock as of market open on a given Date (in USD)
- **High**: Max price of stock during market hours on a given Date (in USD)
- **Low**: Min price of stock during market hours on a given Date (in USD)
- **Close**: Last recorded price of stock before market close on a given Date (in USD)
- **Adj Close**: We can analyze **the change in stock price** over different periods of time using this variable.
- **Volume**: We can analyze **trade activity** over different periods of time using this.

Out of these variables, **Date**, **Adj Close**, and **Volume** are the most important for the purpose of our analysis (not analyzing intra-day changes and 'Close' variable does not reflect corporate actions like dividends, stock splits, etc.).

Supplemental Dataset:

- https://www.macrotrends.net/2015/fed-funds-rate-historical-chart
- This dataset shows the daily level of the federal funds rate back to 1954. The federal funds rate is the interest rate that depository institutions lend to other depository institutions overnight. This is an indicator of monetary policy that investors tend to look at closely, as increases in interest rates make borrowing more expensive, etc.

Introduction:

We want to explore FAANG stock trends/statistics (FAANG = Facebook, Amazon, Apple, Netflix and Google stocks). These companies combined represent all facets of consumer facing goods, from electronics to social media platforms. Investment strategies for firms of all sizes have come to rely on their performance to generate returns for their investors. Being able to predict the movements of these giants can enable huge potential returns. Although our analysis below is more descriptive (not predictive), we believe the insights and trends uncovered can be very useful when trying to understand FAANG stocks better.

Our project aims to answer the following questions:

1. What are the FAANG stocks with the most growth (percent change in stock price)?
2. What are the FAANG stocks with the most volatility in stock price?
3. Which FAANG stocks have the most trade activity?
4. How do FAANG stocks perform during recession periods?

5. How do FAANG stocks perform during rising interest rate periods?
6. What dates/time periods does most FAANG stock activity generally occur?

Data Validation and Cleaning:

Before going into analysis, we had to perform some data validation and cleaning.

Stock Datasets:

The below picture is an example of what 2 of the 5 stock datasets looked like:

```
------------------------------------------------
Google:

         Date       Open       High        Low      Close  Adj Close    Volume
0  2004-08-19  50.050049  52.082081  48.028027  50.220219  50.220219  44659000
1  2004-08-20  50.555557  54.594593  50.300301  54.209209  54.209209  22834300
2  2004-08-23  55.430431  56.796795  54.579578  54.754753  54.754753  18256100
3  2004-08-24  55.675674  55.855854  51.836838  52.487488  52.487488  15247300
4  2004-08-25  52.532532  54.054054  51.991993  53.053055  53.053055   9188600

------------------------------------------------
Netflix:

         Date      Open      High       Low     Close  Adj Close     Volume
0  2002-05-23  1.156429  1.242857  1.145714  1.196429   1.196429  104790000
1  2002-05-24  1.214286  1.225000  1.197143  1.210000   1.210000   11104800
2  2002-05-28  1.213571  1.232143  1.157143  1.157143   1.157143    6609400
3  2002-05-29  1.164286  1.164286  1.085714  1.103571   1.103571    6757800
4  2002-05-30  1.107857  1.107857  1.071429  1.071429   1.071429   10154200
```

Summary of our validation/cleaning for these stock datasets:

- We pulled 5 stock datasets (1 for each FAANG stock) and reviewed/cleaned each. These datasets contain daily stock data from when the company went public to partially through 2020. Due to the abnormal stock market over 2020+ as a result of COVID, we believe using data from 2019 and prior would be best to identify trends for this purpose.
- Confirmed # columns and column names are consistent.
- Removed whitespace from 'Adj Close' column for cleaner syntax/manipulation (renamed to 'Adj_Close').
- Only care about columns: 'Date', 'Adj Close' and 'Volume' for analysis (no analyzing intra-day changes, and 'Close' does not factor in corporate actions like dividends, stock splits, etc.). Dropped other columns.
- Checked for duplicate entries in data and none.
- Checked for null values and Apple had one instance from 1981 that was not significant to our analysis. Identified row and dropped (there was a date value but no 'Adj Close' and 'Volume' data.
- Checked for negative values and none (wouldn't expect in this stock data).
- Glanced at values in data to ensure it seemed reasonable with expectations, and it did.
- Looked at type of all data: 'Date' column was string so changed to datetime type (plan on comparing dates, etc.). Rest of numerical values were good (floats/int).
- Renamed 'Adj Close' and 'Volume' columns to add company name ('Apple_Adj_Close', etc.). This will make columns unique to company for when we merge the 5 company datasets together.
- Rounded 'Adj_Close' floats to 2 decimal places for cleaner look.

Interest Rate Dataset:
The below picture is an example of what the secondary interest rate dataset looked like:

Interest Rates:

	date	value
0	1954-07-01	1.13
1	1954-07-02	1.25
2	1954-07-03	1.25
3	1954-07-04	1.25
4	1954-07-05	0.88
5	1954-07-06	0.25
6	1954-07-07	1.00
7	1954-07-08	1.25
8	1954-07-09	1.25
9	1954-07-10	1.25

Summary of our validation/cleaning for the interest rate dataset:

- We pulled 1 interest rate dataset and reviewed/cleaned (historical federal funds rate which is indicator of monetary policy that investors in stock market scrutinize closely).
- Only 2 columns and we care about both.
- Changed column names:
    - ‘date’ to “Date” to be consistent with the stock datasets.
    - ‘ value’ column had random leading whitespace in name and not a very clear name. Renamed to ‘Int_Rate’.
- Checked for duplicate entries in data and none.
- Checked for null values and only had null values in ‘ value’ column for future dates that were populated in the dataset pull. Identified these rows and dropped (stock datasets only go up to 2020, so do not care about interest rates past then for this analysis anyway).
- Looked at min, max and mean interest rate data and seemed reasonable (no negative interest rates, etc.).
- ‘Date’ column was string so changed to datetime type (plan on comparing dates, etc.). Rest of numerical values were good (floats).

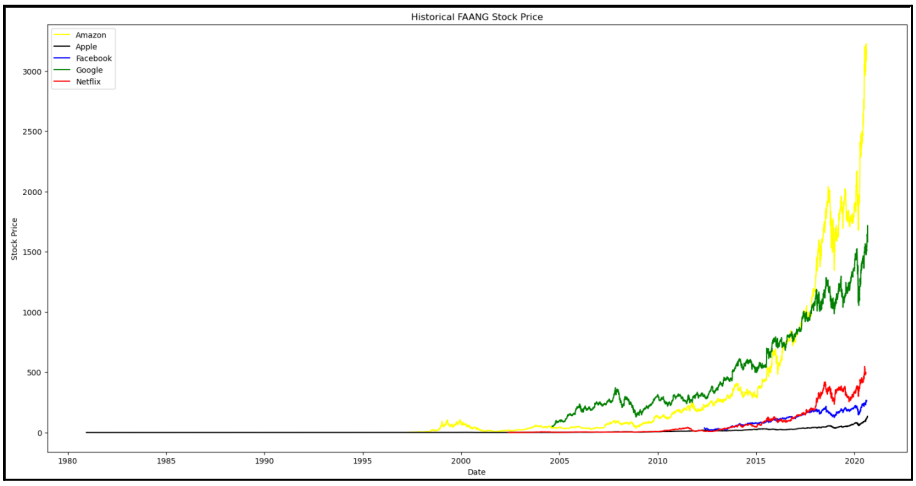
Merged Datasets:
We then merged the clean stock datasets and clean interest rate all together into 1 dataframe, joining on the “Date” columns. Since Apple went public in 1980 and most of the other FAANG stocks did not go public until the 2000s, the merged dataframe contains null values for the stock where data was not available yet, which we expected. This is intentional because we did an outer join with the datasets, as we wanted to keep all available data. We do create separate, distinct annual dataframes for years 2014-2019 later on for unique visualizations and analysis that we complete later on. The picture to the right is an example of info for our distinct 2019 dataframe created. In spot checking these annual dataframes using .info() method in our code, it reveals that nulls are gone and we have nice, clean samples with about 250 entries each (for each work day that year, excluding Saturdays, Sundays, etc.).

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 250 entries, 0 to 249
Data columns (total 12 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   Date                250 non-null    datetime64[ns]
 1   Amazon_Adj_Close    250 non-null    float64
 2   Amazon_Vol          250 non-null    float64
 3   Apple_Adj_Close     250 non-null    float64
 4   Apple_Vol           250 non-null    float64
 5   Facebook_Adj_Close  250 non-null    float64
 6   Facebook_Vol        250 non-null    float64
 7   Google_Adj_Close    250 non-null    float64
 8   Google_Vol          250 non-null    float64
 9   Netflix_Adj_Close   250 non-null    float64
 10  Netflix_Vol         250 non-null    float64
 11  Int_Rate            250 non-null    float64
dtypes: datetime64[ns](1), float64(11)
memory usage: 23.6 KB
```

Initial Plotting of the Main Dataframe
We plot the main dataframe(merged_df) to get a lay of the land, getting a sense for the kinds of analysis we might be able to perform and what to expect from each company. Below are the plot and general insights.

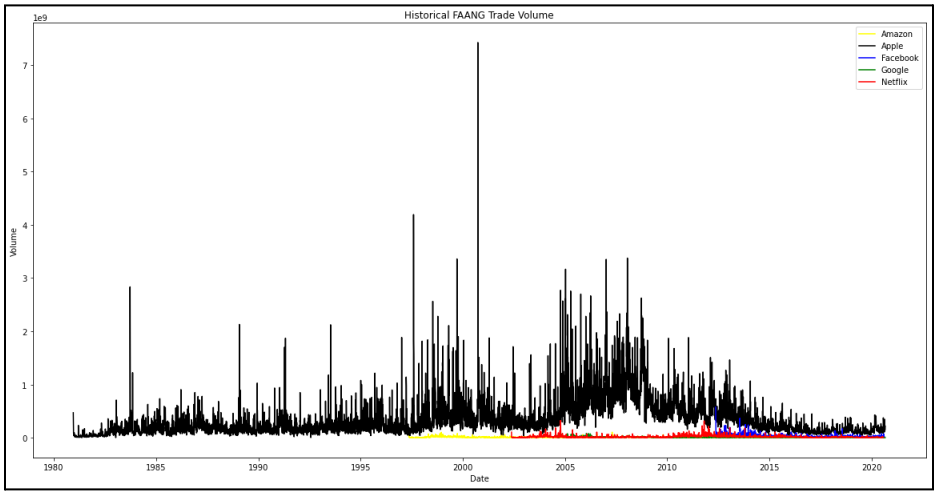
General Insights on Stock Prices:

1. Amazon and Google are most expensive stocks, with Amazon more expensive in recent years 2018+.
2. Apple seems like least expensive stock in all years.
3. Most FAANG stocks have stock data starting in 2000s (first went public).
4. All FAANG stocks seem to rise over the long run.



General Insights on Trading Volume:

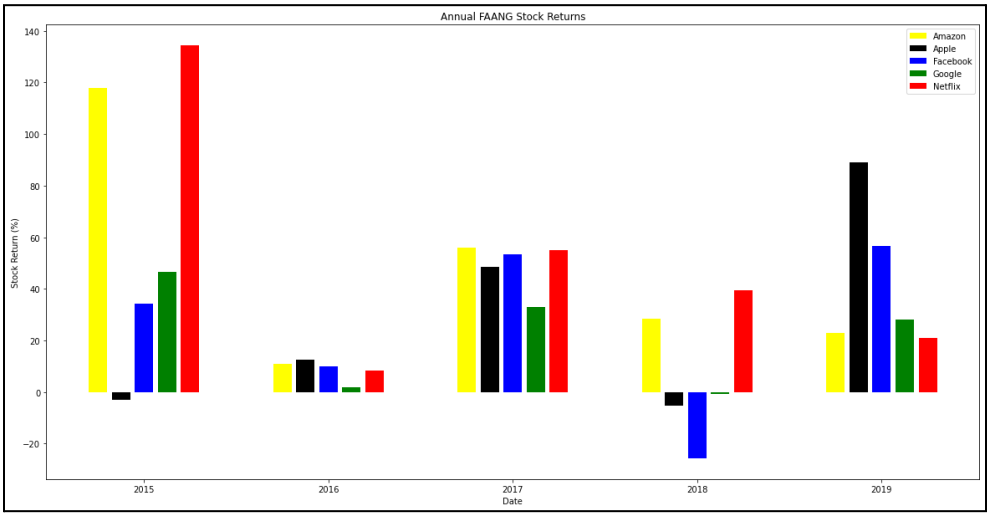
1. Volume refers to the amount of shares or contracts traded in an asset or security over a period of time.
2. Apple stock (black) clearly has the most trade activity over the years by far.
3. Daily volume seems to be very volatile, which makes sense. You would expect the amount traded to vary a lot each day.
4. We will dig into this more in our “Most Trade Activity” question on later on.



(1) What are the FAANG stocks with the most growth (percent change in stock price)?

Insights for Question 1:

1. We focused on 5 recent years of returns (2015-2019).
2. Amazon (yellow) and Netflix (red) seem to have the



best returns over 2015-2019 (and best 5-yr average).
3. Amazon (yellow) and Netflix (red) had incredible returns in 2015 (over 100%)!
4. Google(green) seems to have the worst returns over 2015-2019 (and worst 5-yr average).
5. Facebook(blue) had a bad year in 2018 (worse than a -20% return).

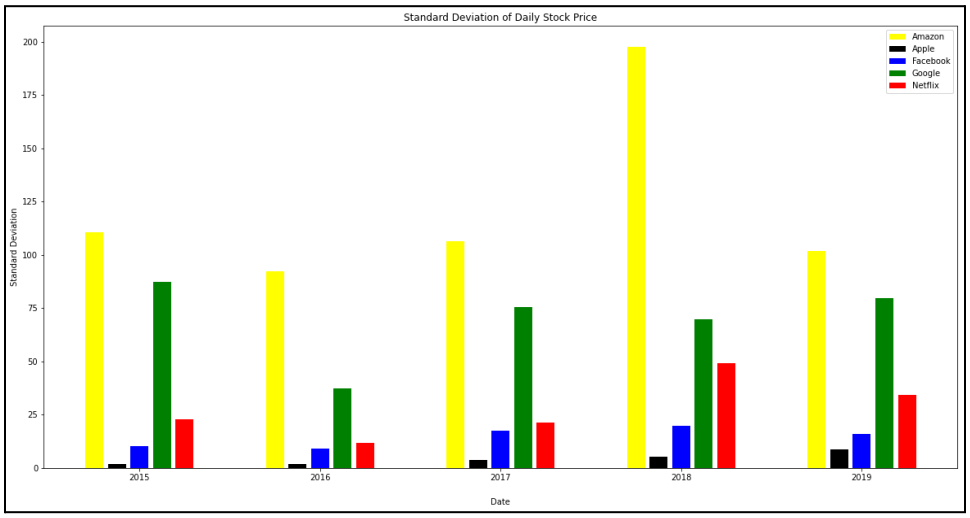
```
5-Yr Average Annual Return (%) Over 2015-2019:

Netflix_Adj_Close     51.6
Amazon_Adj_Close      47.2
Apple_Adj_Close       28.3
Facebook_Adj_Close    25.7
Google_Adj_Close      21.8
dtype: float64
```

(2) What are the FAANG stocks with the most volatility in stock price?

Insights for Question 2:

1. We focused on 5 recent years of stock prices (2015-2019).
2. Amazon (yellow) clearly has the highest daily standard deviation in stock price (for every year over 2015-2019 and lifetime).
3. Google (green) is a close second.
4. Apple (black) clearly has the lowest daily standard deviation in stock price (for every year over 2015-2019 and lifetime).



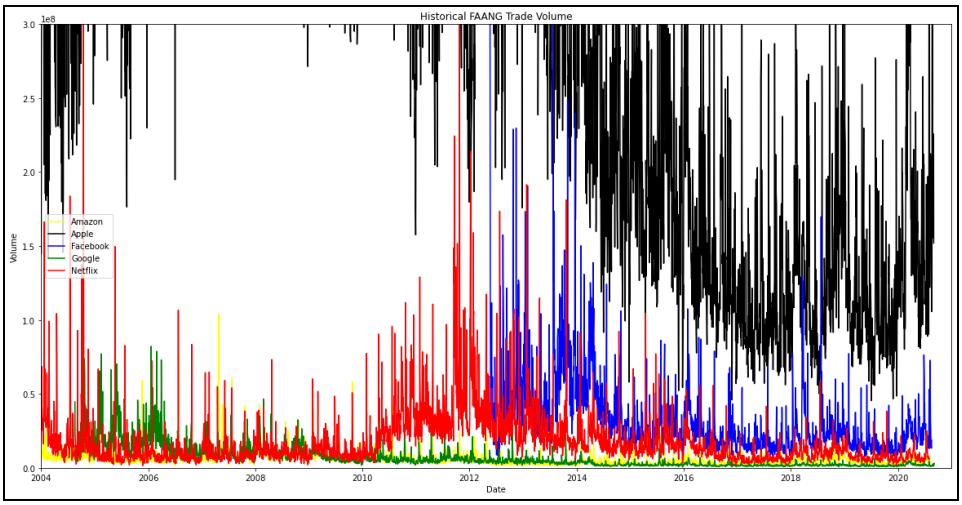

```
Std Deviation of Daily Prices Across All Days in Data:

Amazon_Adj_Close      595.4
Google_Adj_Close      383.0
Netflix_Adj_Close     118.3
Facebook_Adj_Close     61.6
Apple_Adj_Close        16.4
dtype: float64
```

(3) Which FAANG stocks have the most trade activity?

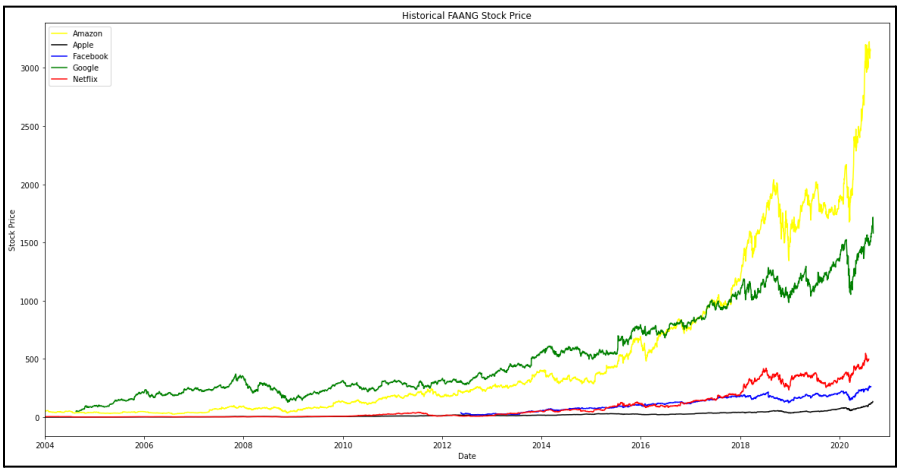
Insights for Question 3:

1. Volume refers to the number (not dollar value) of shares or contracts traded in an asset or security over a period of time.
2. Apple (black) shows to be the most actively



traded FAANG stock by far. Next is Facebook (blue) and Netflix (red).

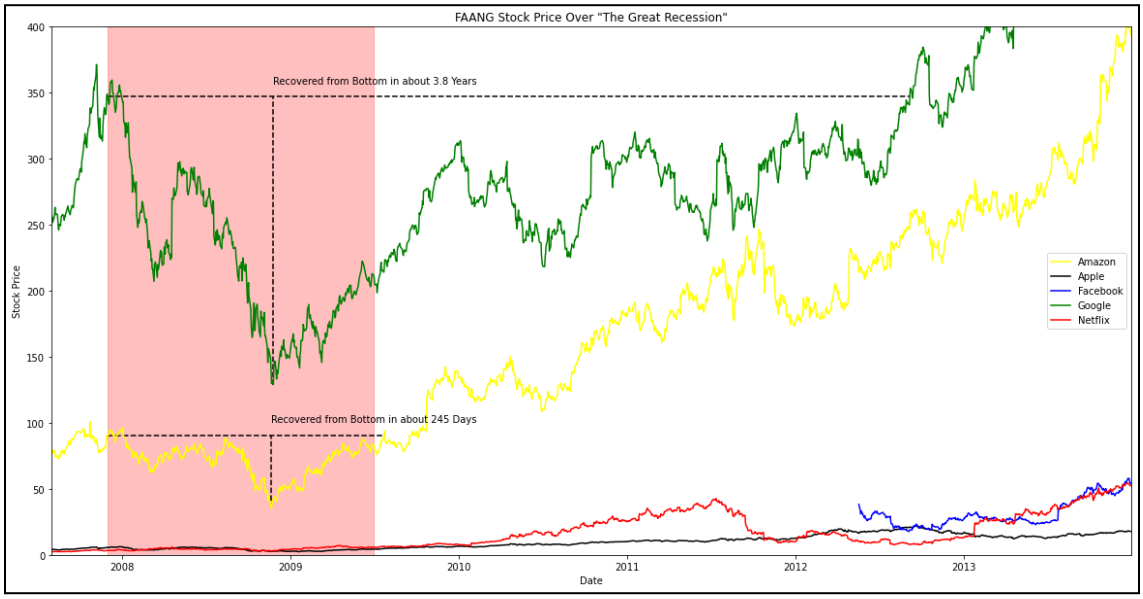
3. Google (green) and Amazon (yellow) are the least traded FAANG stocks by volume.
4. Looking back at the stock price chart from earlier (shown to the right), we notice that the cheapest FAANG stocks are traded the most by people, while the expensive FAANG stocks are traded the least.



5. We also noticed that although Apple has a huge amount of trade activity compared to other FAANG stocks, the stock price does not shoot up like one might expect if everyone was buying the stock. This implies that there is likely a fair amount of both buyers/sellers of the stock.

(4) How do FAANG stocks perform during recession periods?

For brevity, the image to the right highlights how Amazon and Google recovered over the last major economic disaster in recent memory, The Great Recession of 2008 (Dec. 2007 - June 2009).



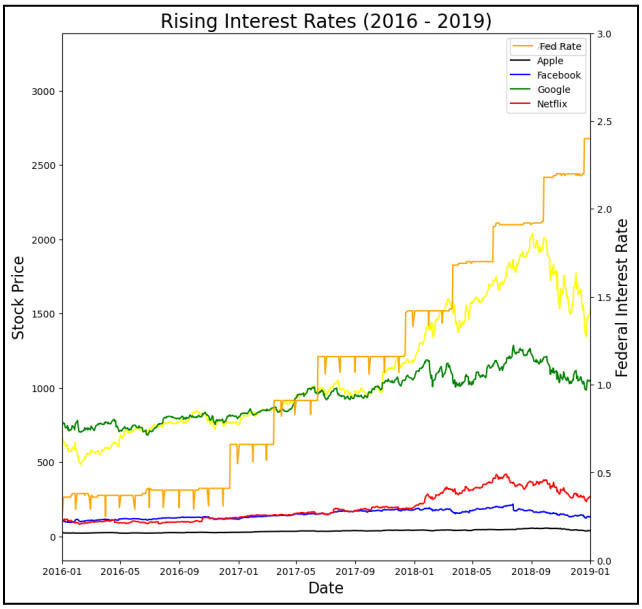
Insights for Question 4:

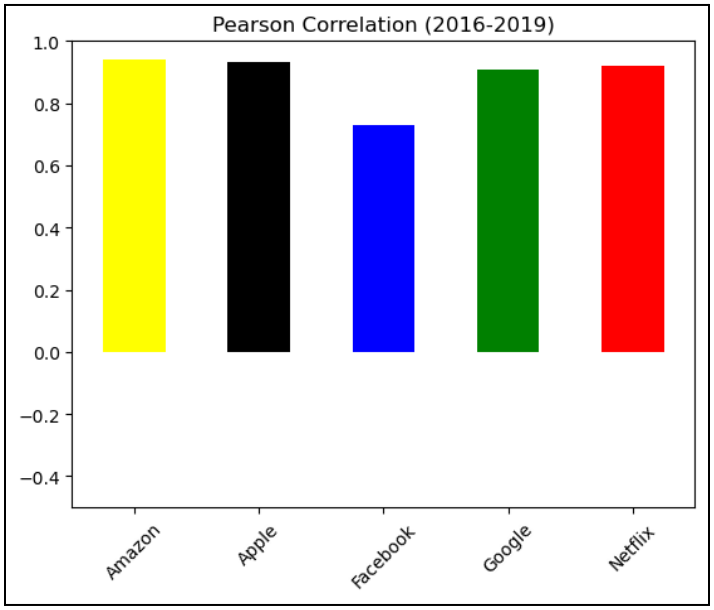
1. We analyzed FAANG stock prices over recessions where we have data (The Dot-Bomb Recession March 2001-Nov 2001, and The Great Recession Dec 2007-Jun 2009).
2. We measured the pre-recession stock price, the bottom price during the recession, and the date when the stock gets back to the pre-recession price from the bottom.
    a. An alternate way we could have measured was by looking at the highest price from day

before recession to the bottom during recession, look at the bottom price during the recession, and the date the stock gets back to that highest price. Based on visualizing this on the charts, this would not have changed our conclusions.

3. Although recessions caused volatility in the FAANG stock prices and likely caused a lot of panic, all FAANG stocks have recovered to their pre-recession price! Majority recovered within 1 year (Google took 3.8 years over The Great Recession).
4. Another item to note is that the FAANG companies were nowhere near the giants they are today when they powered through the recessions.

(5) How do FAANG stocks perform during rising interest rates?



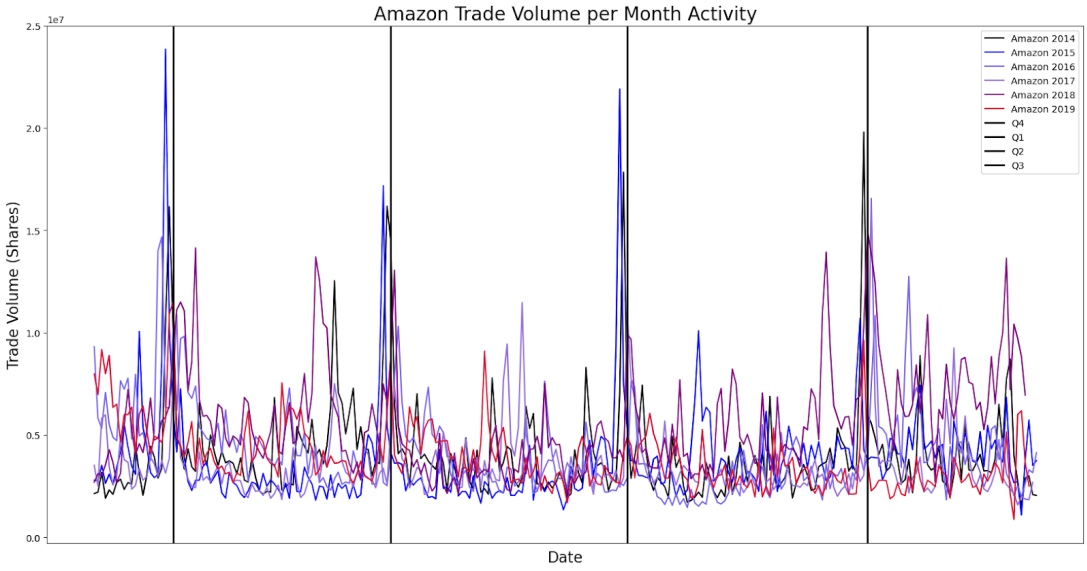


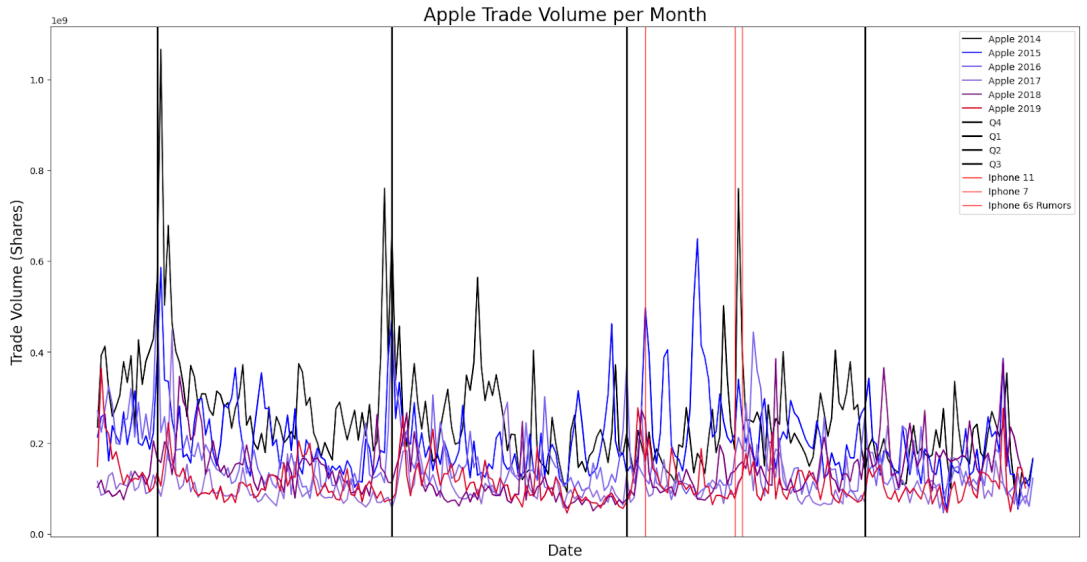
To perform this analysis we first identified an area where the federal interest rates were steadily increasing, such as the period between 2016 and the end of 2018. To determine if the interest rate was potentially affecting the stock prices we relied on a statistical tool called a Pearson Correlation which return a value between -1 and 1.

For example, if two variables are perfectly negatively correlated, a Pearson correlation of -1 would indicate that as one variable increases, the other decreases by the same amount. On the other hand, if the two variables are not related, a Pearson correlation of 0 would indicate that changes in one variable do not have any effect on the other.

Rising interest rates see every company gaining stock value, with a Pearson Correlation hovering above +0.8 for most. This could be caused by a 'hot' market where the federal interest rate is trying to restrict access to credit and reduce buying power. Under this interpretation, Interest rate could be acting as a brake, keeping prices under control, until the market eventually corrects and cools down.

(6) What time periods does FAANG stock activity generally occur?





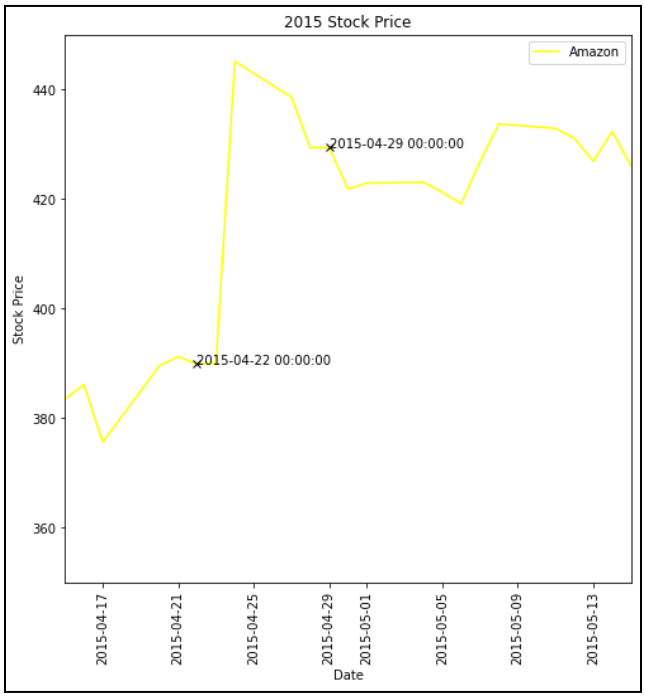
With this section are included two graphs, one of Amazon and one of Apple. These two companies engage in entirely different forms of business. Amazon is a web retail giant which sees sales year round and has no major announcement or events save the end of year holidays and Apple is a consumer technology company that releases hardware on a yearly cadence.

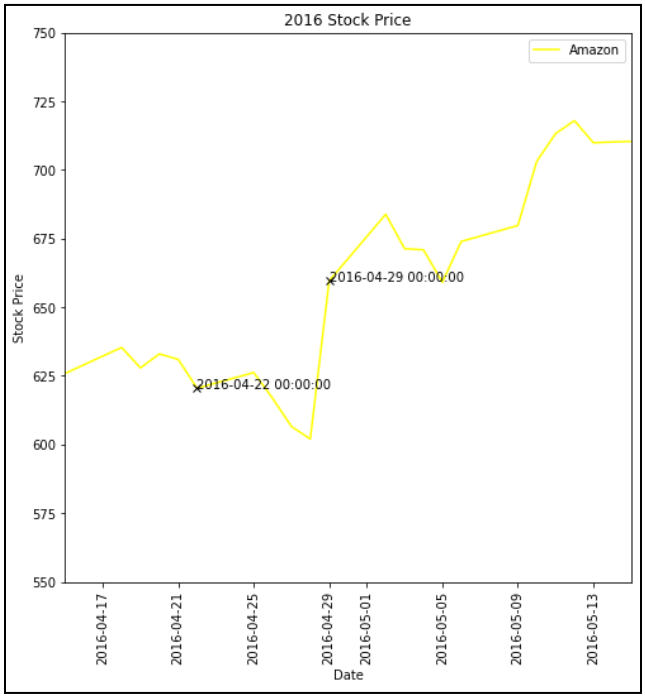
Above we can see that Amazon has spikes in trade volume like clockwork every year once a quarter before and after earnings calls, and elevated trade activity later in the year. If we look at Apple we can find a similar pattern for Q4, and Q1 calls but it falls apart as their hardware release events approach. Of interest is that we can see spikes that align with leaks and rumors about new iPhones along with spikes that occur shortly before and after their release events.

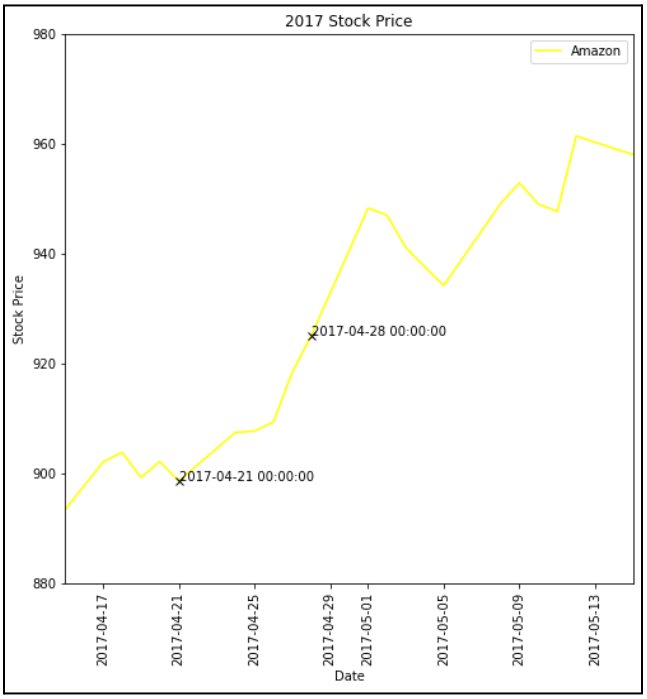
Other Interesting Trends: “Sell in May” Run-Up?

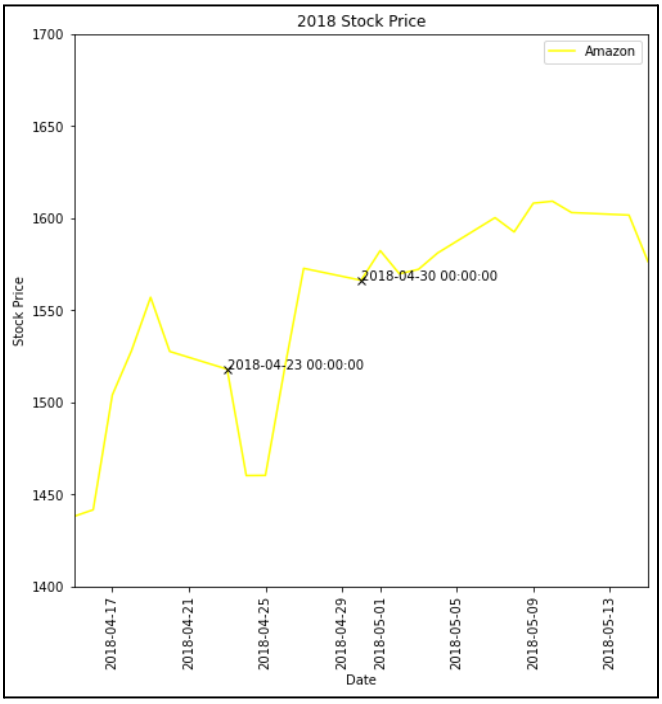
Insights:

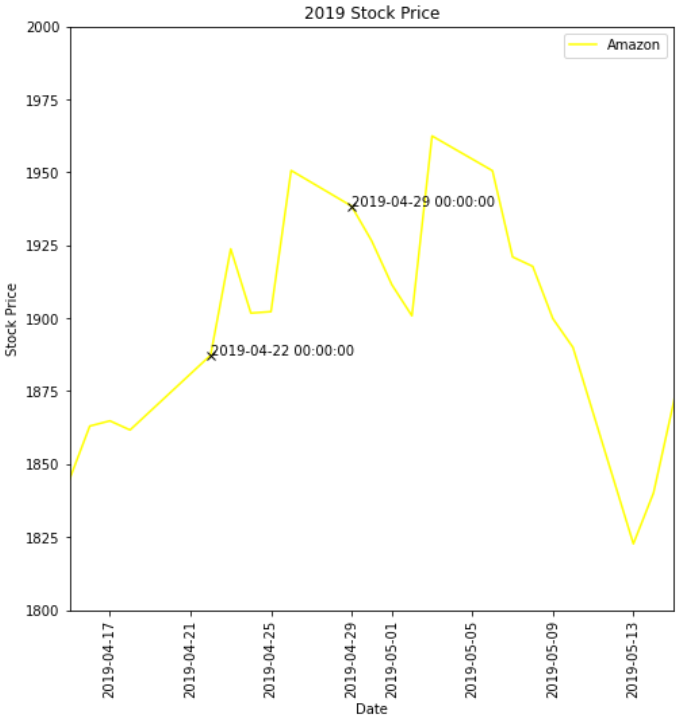
1. There is a term people refer to as "Sell in May" in the stock market, where people sell stock around May to pay for summer vacations, etc.
2. We wanted to look into this period over the years to see if there are any actual trends here.
3. We used Amazon over the past 5 years for this analysis.
4. In initial plotting, we were expecting to see a sell off in May (declining stock price). We did see this, however, we identified something even more interesting; a recurring trend where the stock price runs up right before the May sell-off starts.
5. It looks like if you would have bought on 4-22 and sold on 4-29 (or closest business day), you would have always made money over the past 5 years!











Conclusion

We conclude that there are insightful trends and statistics with FAANG stocks. Although we dug into a lot to understand FAANG stocks better, we are summarizing some of the key items that we identified in our explorations:

- Although they can be volatile, all **FAANG stocks have increased in price over the long term**.
- Trade Volume and Price for FAANG stocks are negatively correlated. **We see that the cheapest FAANG stocks are traded the most and the most expensive are traded the least**. Apple is the cheapest FAANG stock and traded the most by far.
    - It would be interesting to see if this generalizes outside of FAANG stocks. For example, do all cheaper stocks have higher trade activity than stocks that are more expensive? What about if the cheaper stocks do not perform as well as the more expensive stocks?
- Although recessions caused volatility in the FAANG stock prices and likely a lot of panic, **all FAANG stocks have recovered to their pre-recession prices** (over The Dot-Boom Recession and The Great Recession). Majority recovered within 1 year (Google took 3.8 years over The Great Recession).
- **Amazon stock price has a consistent run up every year before May (according to years analyzed, 2015-2019)**. We identified that if you would have purchased Amazon stock on 4-22 and sold on 4-29 (or closest business days), you would have always made money over the past 5 years!
    - It would be interesting to see if this run-up that we identified is consistent across all FAANG and outside of FAANG. It would also be interesting to see if this was consistent in recent COVID years.

Appendix

Data Structure:

- Date
  - Example: 2020-08-26
  - Date expressed in Year, Month, Day
  - We can analyze various trends/statistics **over different periods of time** using this variable.
- Open
  - Example: 126.180000
  - Price of stock as of market open on a given Date, expressed in USD
- High
  - Example: 126.992500
  - Max price of stock during market hours on a given Date, expressed in USD
- Low
  - Example: 125.082497
  - Min price of stock during market hours on a given Date, expressed in USD
- Close
  - Example: 126.522499
  - Last recorded price of stock before market close on a given Date, expressed in USD
- Adj_Close
  - Example: 126.522499
  - An adjusted closing value accounting for corporate actions, expressed in USD
  - We can analyze **the change in stock price** over different periods of time using this variable.
- Volume
  - Example: 163022400.0
  - The number of shares traded during market hours on a given Date
  - We can analyze **the trade activity** over different periods of time using this variable.