

# Interest Rate Impact on Stock Prices

*Impact of US Federal Interest Rate Policy on Forward-Looking Valuations of Large Businesses*

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*GitHub repo: <https://github.com/ryanmcr17/project1>*

# Project Plan/Details

# Project Description and Background

Analysis of US interest rate policy relative to large US company valuations. Interest rate policy is represented by effective federal funds rates, set by the Federal Open Market Committee (FOMC) within the Federal Reserve central bank of the US. Forward-looking valuations of large companies are represented by S&P 500 Price-to-Earnings (PE) Ratio data.

Anecdotally, and very generally, businesses typically see stronger revenue/earnings growth when interest rates are lower, at least when other economic conditions are equivalent (employment rates / labor market conditions and inflation rates especially). When the Fed/FOMC 'tightens' interest rate policy by raising their Fed Funds target rate range (i.e. 'raising interest rates') that often negatively impacts future business growth/profits and therefore current forward-looking valuations (in the form of stock prices). However, forward-looking valuations of large US businesses are dependent upon many factors beyond just interest rates, and many of those factors likely impact both valuations as well as federal interest rates themselves (confounding factors). I'm curious to explore the direct relationship mathematically to see how strong it may be, while understanding that a much more thorough analysis would be necessary to truly understand the complex relationship between these two variables and that an especially strong negative correlation (r-value close to -1) is highly unlikely.

# Key Questions Considered

- What do the distributions of values look like from each individual dataset?
- What values/periods from each dataset could be considered outliers?
- Is there a consistent (negative) correlation between Effective Fed Funds Rates and S&P 500 PE ratios/valuations?
- Do potential outlier data points (whether included or removed) have a significant impact on the level of correlation between the two datasets?

**Process Taken**

# Data Cleansing

# Data Sources

US federal interest rate data by month obtained from [Kaggle](#), S&P 500 PE ratios by month obtained from [NASDAQ Data Link API](#)

The screenshot shows the Kaggle website interface. The left sidebar contains navigation links: Home, Competitions, Datasets, Models, Code, Discussions, Learn, and More. The main content area displays the dataset 'FEDERAL RESERVE - UPDATED 6 YEARS AGO' with a title 'Federal Reserve Interest Rates, 1954-Present' and a description 'Interest rates, economic growth, unemployment, and inflation data'. Below the title are tabs for 'Data Card', 'Code (16)', and 'Discussion (0)'. The 'About Dataset' section is visible, and a 'Context' section is partially shown at the bottom.

The screenshot shows the Nasdaq Data Link website interface. The top navigation bar includes 'Nasdaq Data Link', a search bar, and an 'EXPLORE' button. Below the navigation bar are tabs for 'ALL TOOLS', 'API', 'R', 'PYTHON', 'EXCEL', and 'RUBY'. The main content area features a large blue banner with the text 'Financial Data API' and a sub-header 'Access millions of financial and economic data points from hundreds of publishers via the Nasdaq Data Link suite of APIs.' An 'EXPLORE' button is located at the bottom right of the banner.

```
1 # Kaggle authentication + CSV download with interest rate data + processing into DataFrame
2
3 import kaggle
4 kaggle.api.authenticate()
5
6 kaggle.api.dataset_download_files('federalreserve/interest-rates', unzip=True)
7 os.rename('./index.csv', './rates-data.csv')
8 rates_df = pd.read_csv('./rates-data.csv')
9
10 rates_df.head(10)
11
```

	Year	Month	Day	Federal Funds Target Rate	Federal Funds Upper Target	Federal Funds Lower Target	Effective Federal Funds Rate	Real GDP (Percent Change)	Unemployment Rate	Inflation Rate
0	1954	7	1	NaN	NaN	NaN	0.80	4.6	5.8	NaN
1	1954	8	1	NaN	NaN	NaN	1.22	NaN	6.0	NaN
2	1954	9	1	NaN	NaN	NaN	1.06	NaN	6.1	NaN
3	1954	10	1	NaN	NaN	NaN	0.85	8.0	5.7	NaN
4	1954	11	1	NaN	NaN	NaN	0.83	NaN	5.3	NaN
5	1954	12	1	NaN	NaN	NaN	1.28	NaN	5.0	NaN
6	1955	1	1	NaN	NaN	NaN	1.39	11.9	4.9	NaN
7	1955	2	1	NaN	NaN	NaN	1.29	NaN	4.7	NaN
8	1955	3	1	NaN	NaN	NaN	1.35	NaN	4.6	NaN

```
1 # NASDAQ API URL setup + download of S&P 500 PE-ratio data + processing into DataFrame
2
3 from api_keys import nasdaq_api_key
4
5 dataset_code = 'MULTPL/SP500_PE_RATIO_MONTH'
6
7 nasdaq_url = f'https://data.nasdaq.com/api/v3/datasets/{dataset_code}.json?api_key={nasdaq_api_key}'
8
9 response = requests.get(nasdaq_url).json()
10
11
12 pe_df = pd.DataFrame(response['dataset']['data'])
13
14 pe_df.rename(columns={0: 'Date', 1: 'S&P 500 PE Ratio'}, inplace=True)
15
16 pe_df.head(10)
17
```

	Date	S&P 500 PE Ratio
0	2023-07-01	25.78
1	2023-06-30	25.76
2	2023-06-01	25.15
3	2023-05-31	24.20
4	2023-05-01	24.00
5	2023-04-01	23.86
6	2023-03-31	21.97

# Merged Data

*Matched formatting of date data between dataframes, used inner merge to combine while dropping duplicative end-of-month datapoints, created new clean dataframe with only necessary columns/data*

	Date	S&P 500 PE Ratio	Year	Month	Day	Federal Funds Target Rate	Federal Funds Upper Target	Federal Funds Lower Target	Effective Federal Funds Rate	Real GDP (Percent Change)	Unemployment Rate	Inflation Rate	Month2	Day2
0	2017-03-01	23.60	2017	3	1	NaN	0.75							
1	2017-02-01	23.68	2017	2	1	NaN	0.75							
2	2017-01-01	23.59	2017	1	1	NaN	0.75							
3	2016-12-01	23.76	2016	12	1	NaN	0.50							
4	2016-11-01	23.35	2016	11	1	NaN	0.50							

```
1 # Reduce to primary columns for analysis, using Effective Federal Funds Rate to represent rates
2
3 clean_df = combined_df[['Date', 'S&P 500 PE Ratio', 'Effective Federal Funds Rate']].dropna().sort_values('Date', ignore_index=True)
4
5 print(clean_df.count())
6
7 clean_df.head(50)
8
```

```
Date                752
S&P 500 PE Ratio      752
Effective Federal Funds Rate  752
dtype: int64
```

	Date	S&P 500 PE Ratio	Effective Federal Funds Rate
0	1954-07-01	11.49	0.80
1	1954-08-01	11.70	1.22
2	1954-09-01	11.96	1.06
3	1954-10-01	12.02	0.85
4	1954-11-01	12.28	0.83
5	1954-12-01	12.62	1.28
6	1955-01-01	12.56	1.39
7	1955-02-01	12.70	1.29
8	1955-03-01	12.33	1.35
9	1955-04-01	12.39	1.43



# Merged Data

*Matched format of date data in rate dataframe with that in PE dataframe, used inner merge to combine while dropping end-of-month datapoints from rate dataframe leaving only start-of-month rows*

	Date	S&P 500 PE Ratio	Year	Month	Day	Federal Funds Target Rate	Federal Funds Upper Target	Federal Funds Lower Target	Effective Federal Funds Rate	Real GDP (Percent Change)	Unemployment Rate	Inflation Rate	Month2	Day2
0	2017-03-01	23.60	2017	3	1	NaN	0.75	0.50	NaN	NaN	NaN	NaN	03	01
1	2017-02-01	23.68	2017	2	1	NaN	0.75	0.50	0.66	NaN	4.7	2.2	02	01
2	2017-01-01	23.59	2017	1	1	NaN	0.75	0.50	0.65	NaN	4.8	2.3	01	01
3	2016-12-01	23.76	2016	12	1	NaN	0.50	0.25	0.54	NaN	4.7	2.2	12	01
4	2016-11-01	23.35	2016	11	1	NaN	0.50	0.25	0.41	NaN	4.6	2.1	11	01

# Appendix

# Additional Interesting Questions for Future Analysis

- Considering the potential time-lag in impact of interest rates on PE ratios, is there a stronger correlation between the two variables if accounting for that time-lag by shifting the x-axis for one of the variables relative to the other?
- What other factors/variables likely impact US company valuations / PE ratios that should be considered through additional analyses? Which of those may also have an impact on interest rate policy / future rates themselves?

# Additional Notes on Original Plan/Datasets

Originally considered looking at tech company valuations specifically, via NASDAQ index PE ratios and because interest rates anecdotally seem to have a greater impact on tech company valuations due to longer average time-to-value industry-wide. Went with broader S&P 500 index data because it's available across a much longer time period, and Fed interest rates move quite slowly over years and differently over decades.

# Acknowledgements and Data Sources

- pulling code from week-06/module-06 'WeatherPy' challenge as starting point for data loading
- federal interest rate data by month obtained from Kaggle (<https://www.kaggle.com/datasets/federalreserve/interest-rates>)
- S&P 500 PE ratios by month obtained from NASDAQ Data Link API (<https://docs.data.nasdaq.com/docs/python-time-series>)