Financial Data Analysis Project

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Executive Summary:

- The project aimed to analyse the impact of interest rate changes on chosen sectors in the Financial market, focusing on performance trends, sector volatility, and correlations within an interest rate cycle. The study delved into how sectors respond during two phases of an interest rate cycle, while interest rates are rising and while interest rates are falling.

Key Questions :

1. Performance Trends:

- *Which sectors are the highest/lowest performing in a rising interest rate environment as opposed to a falling interest rate environment?*

2 Sector Volatility:

- *What observations can be made regarding sector volatility amidst shifts in interest rates between periods of rising and falling interest rates?*

3 .Correlations:

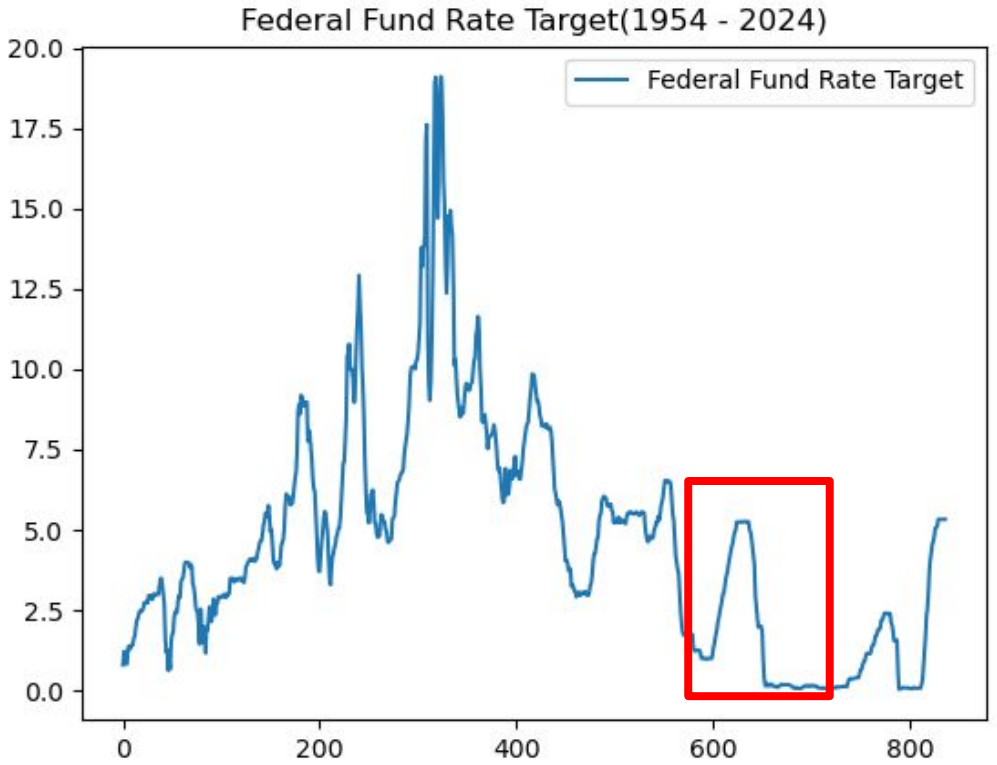
- *What correlations exist between sector performance during rising and falling interest rate environments, and how do these correlations vary across different phases of interest rate cycles?*

Significance:

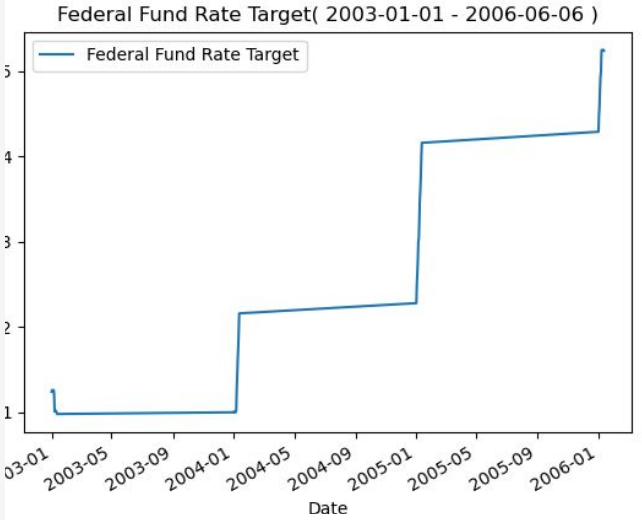
- This project provides crucial insights into how various sectors in the Financial market react to changes in interest rates, offering a strategic advantage for investors and analysts in making informed decisions, managing risks effectively, and optimising portfolio allocations. Understanding sector dynamics amidst interest rate fluctuations is paramount for navigating turbulent market conditions and maximising investment returns.

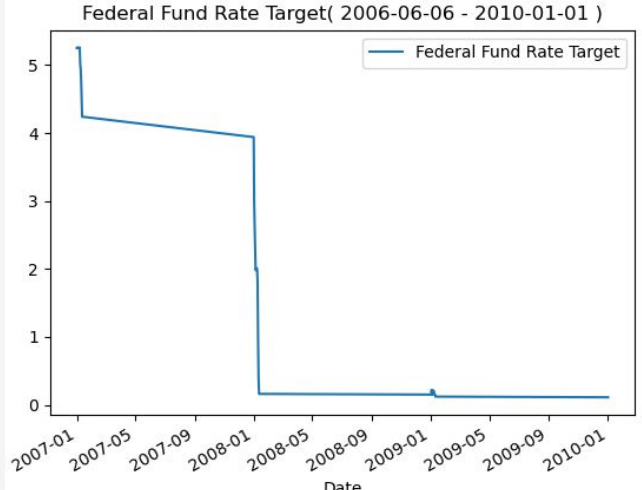
Our Approach

```
path = './CSV_DATA/FEDFUND_DF.csv'


# Import data frame of all
# interest rate cycles from 1954-2024.
df = pd.read_csv(path)

# Plot the interest rates
# from 1954 to 2024.
df.plot()
plt.title(f'Federal Fund Rate
           Target(1954 - 2024)')
plt.savefig(
    f'./Saved_Figures/Interest_Rate_Grap
    ALL_FEDERAL_FUND_RATES(1954-2024).pr
```



```python
# Import data frame of all interest rate cycles from 1954-2024.
FedFund_df = pd.read_csv('./CSV_DATA/FEDFUND_DF.csv')

# Rename Date column to be conistent with other Date Column Names.
FedFund_df = FedFund_df.rename(columns={'date': 'Date'})

# Convert 'Date' column to datetime format-
    # Allows us to filter data via the dates.
FedFund_df['Date'] = pd.to_datetime(FedFund_df['Date'])

# Create Labels for filtered datafames and figures of two interest rate cycles.
labels = ['Total_Fed_Cycle','FedFund_Rising','FedFund_Lowering']

# Define start and end dates.
    # This code captures the entire 2008 interest rate cycle,
    # and the rising and falling parts of the interest rates cycle.
start_date = ['2003-01-01',          '2003-01-01',          '2006-06-06']
end_date =   ['2010-01-01',          '2006-06-06',          '2010-01-01']

    # Filter DataFrame between start and end dates
for i in range(0,len(start_date)):
    FedFund_TS = FedFund_df[(FedFund_df['Date'] >= start_date[i]) & (FedFund_df['Date'] <= end_date[i])]
    FedFund_TS.plot('Date','Federal Fund Rate Target')
    plt.title(f'Federal Fund Rate Target( {start_date[i]} - {end_date[i]} )')
    # Save the figures
    plt.savefig(f'./Saved_Figures/Interest_Rate_Graphs/{labels[i]}_{start_date[i]}_to_{end_date[i]}.png')
```





8 - SECTORS

The datasets were then sourced from Yahoo Finance,

1. Energy
2. Materials
3. Industrials
4. Consumer Discretionary
5. Consumer Staples
6. Health Care
7. Financials
8. Information Technology

Data Collection and Clean Up

Data Collection & Clean-up Process

Data Collection Methodology

- Collect data from the Yahoo Finance
- Collect data from the Federal Reserve (FRED)

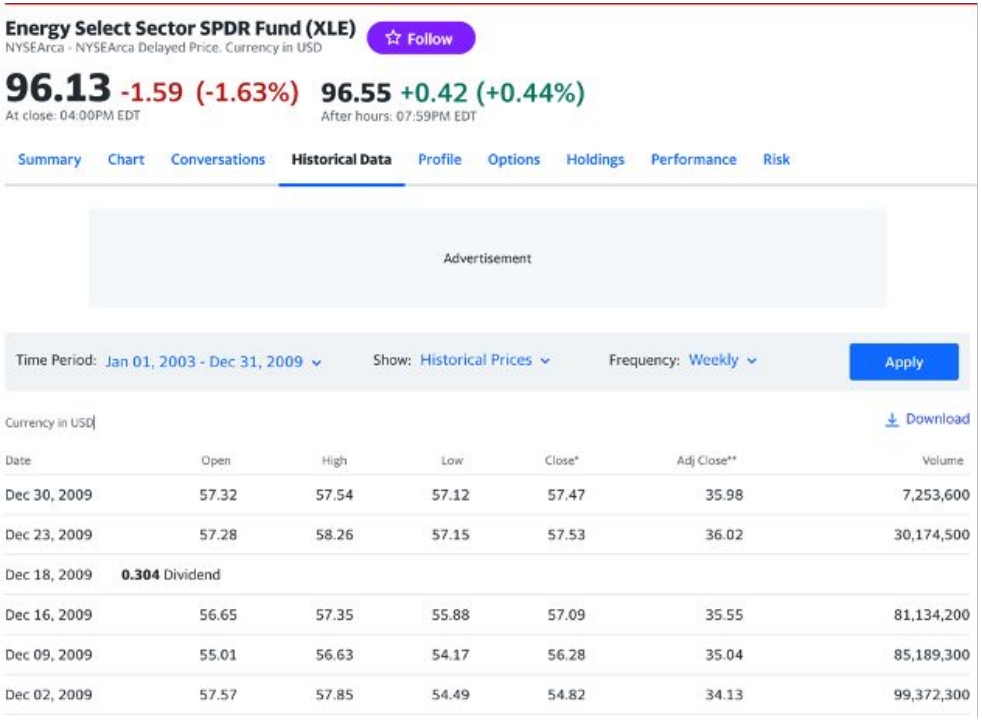
Data Clean-up Procedure

- Clean-up process for the industry sector datasets
- Clean-up process for the Federal Fund Rate dataset

Data Collection Methodology

Collect Data from Yahoo Finance

We conducted searches for each industry sector and directly downloaded their respective historical price data from the website, saving the information in CSV file format.



Energy Select Sector SPDR Fund (XLE) Follow

NYSEArca - NYSEArca Delayed Price. Currency in USD

96.13 -1.59 (-1.63%) At close: 04:00PM EDT

96.55 +0.42 (+0.44%) After hours: 07:59PM EDT

Summary | Chart | Conversations | Historical Data | Profile | Options | Holdings | Performance | Risk

Advertisement

Time Period: Jan 01, 2003 - Dec 31, 2009 Show: Historical Prices Frequency: Weekly Apply

Currency in USD Download

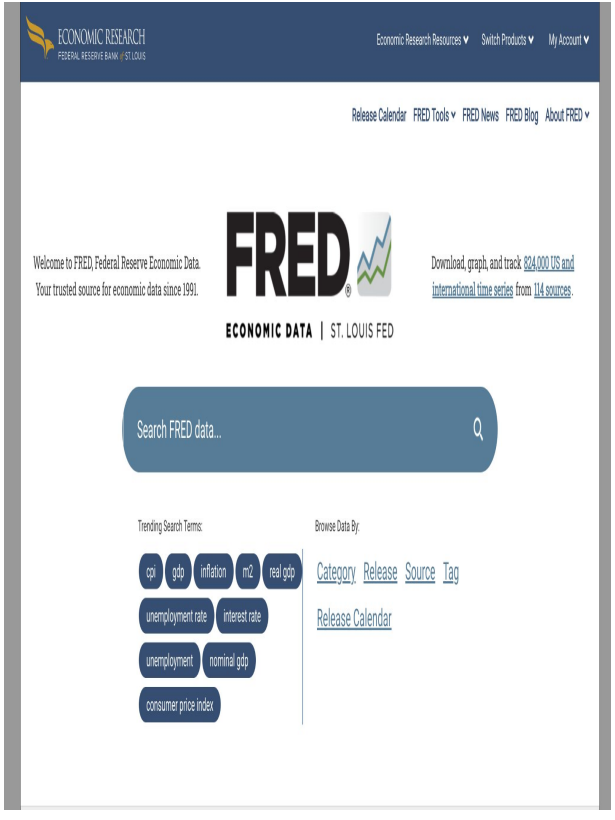
Date	Open	High	Low	Close*	Adj Close**	Volume
Dec 30, 2009	57.32	57.54	57.12	57.47	35.98	7,253,600
Dec 23, 2009	57.28	58.26	57.15	57.53	36.02	30,174,500
Dec 18, 2009	**0.304** Dividend					
Dec 16, 2009	56.65	57.35	55.88	57.09	35.55	81,134,200
Dec 09, 2009	55.01	56.63	54.17	56.28	35.04	85,189,300
Dec 02, 2009	57.57	57.85	54.49	54.82	34.13	99,372,300

Collect Data from The Federal Reserve

We obtained the dataset comprising the federal funds rate target spanning from 1954 to 2024 from the FRED (Federal Reserve Economic Data) platform

```
Federal_Reserve_Time_Series_Endpoint = 'https://api.stlouisfed.org/fred/series/observations?'

# Returns target federal funding base rates.
series_id_FedRate = 'series_id=FEDFUNDS'

# Determines which output type.
file_type = 'file_type=json'

# limit
# The maximum number of results to return.

# integer between 1 and 1000, optional, default: 1000
```

```
url = f'{Federal_Reserve_Time_Series_Endpoint}{series_id_FedRate}&{api_key}&{file_type}'

response = requests.get(url).json()
# response

# Convert 'observations' from JSON into DataFrame
json_df = pd.DataFrame(response['observations'])

# Convert 'value' column to numeric
json_df['value'] = pd.to_numeric(json_df['value'])

FEDFUND_DF = json_df.loc[:, ['date', 'value']]
```



Data Clean-up Procedure

Clean-up Process for industry dataset

For the industry sector datasets, we loaded each sector's CSV data into a Data Frame and proceeded with the following steps:

1. Utilised a filter function to extract data
2. Renamed the 'Close' column to match the sector name within the sector Data
3. Merged them into a single Data Frame for subsequent phases of analysis.

[21]:
```
# XLV Healthcare
path = './CSV_DATA/XLV_HEALTHCARE.csv'
Healthcare_df = pd.read_csv(path)
HEALTHCARE_DF = Healthcare_df[['Date', 'Close']]
HEALTHCARE_DF = HEALTHCARE_DF.rename(columns={'Close': 'Healthcare'})
HEALTHCARE_DF
```

[21]:

	Date	Healthcare
0	2003-01-01	27.450001
1	2003-01-08	27.510000
2	2003-01-15	26.900000
3	2003-01-22	26.180000
4	2003-01-29	26.040001

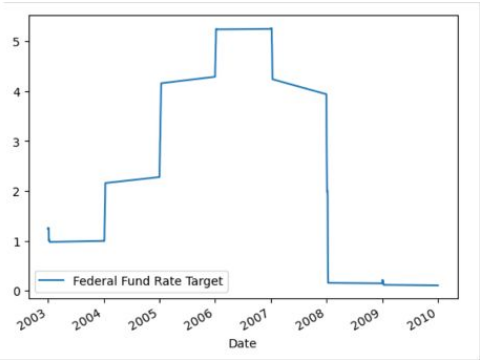
```
# Merge all DataFrames on the 'Date' column
merged_df = pd.merge(ENERGY_DF, MATERIALS_DF, on='Date', how='outer')
merged_df = pd.merge(merged_df, INDUSTRIALS_DF, on='Date', how='outer')
merged_df = pd.merge(merged_df, CONSUMER_DF, on='Date', how='outer')
merged_df = pd.merge(merged_df, STAPLES_DF, on='Date', how='outer')
merged_df = pd.merge(merged_df, HEALTHCARE_DF, on='Date', how='outer')
merged_df = pd.merge(merged_df, FINANCIALS_DF, on='Date', how='outer')
merged_df = pd.merge(merged_df, TECH_DF, on='Date', how='outer')
merged_df = pd.merge(merged_df, UTILITIES_DF, on='Date', how='outer')
```

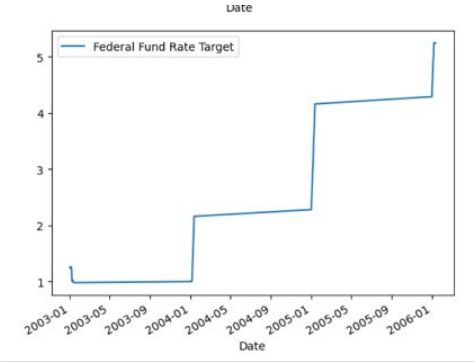
Clean-up Process for Federal Fund Rate dataset

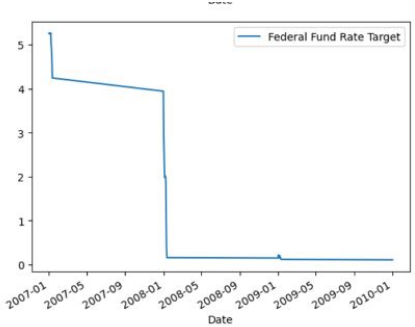
For the Federal Fund Rate dataset obtained from the Federal Reserve (FED), this dataset is categorised into three distinct segments:

1. The 'full cycle' interest rates, covering the period from 2003 to 2010.
2. The 'rising interest rate' period, encompassing rates from 2003 to 2006.
3. The 'declining interest rate' period, spanning from 2006 to 2010.

```
# Create Labels for filtered datafames and figures of two interest rate cycles.
labels = ['Total_Fed_Cycle','FedFund_Rising','FedFund_Lowering']

# Define start and end dates.
    # This code captures the entire 2008 interest rate cycle,
    # and the rising and falling parts of the interest rates cycle.
start_date = ['2003-01-01',          '2003-01-01',          '2006-06-06']
end_date =   ['2010-01-01',          '2006-06-06',          '2010-01-01']
```

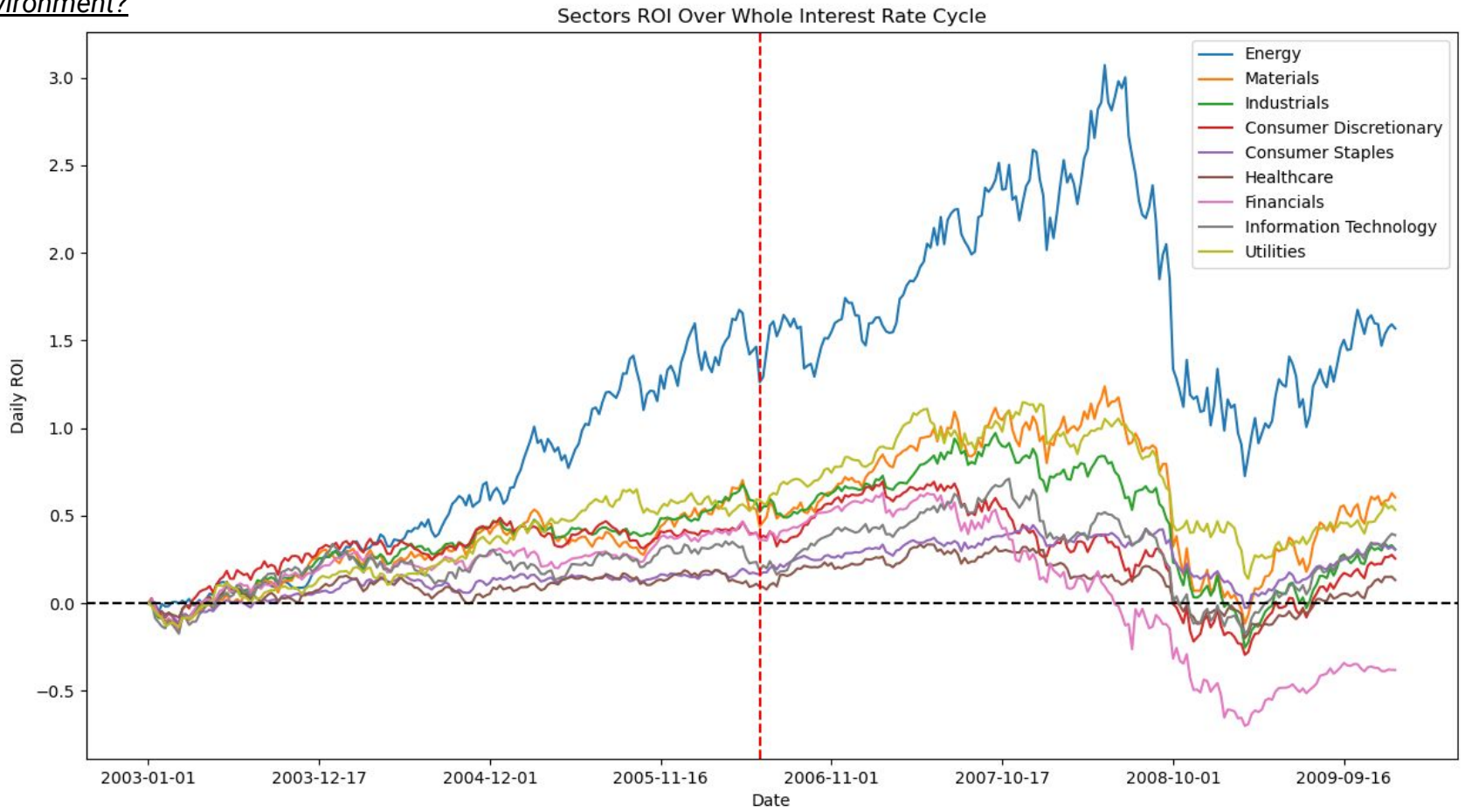


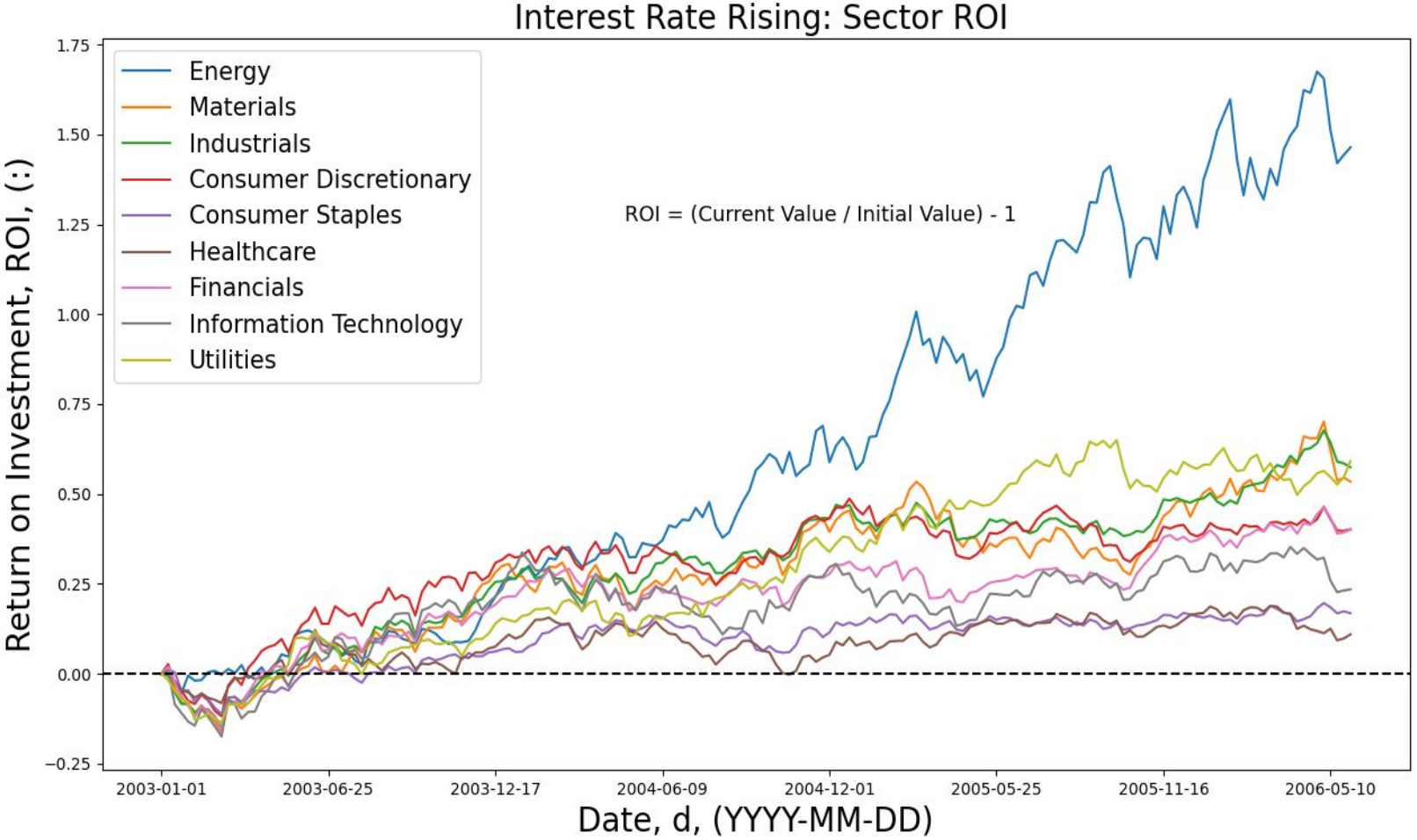


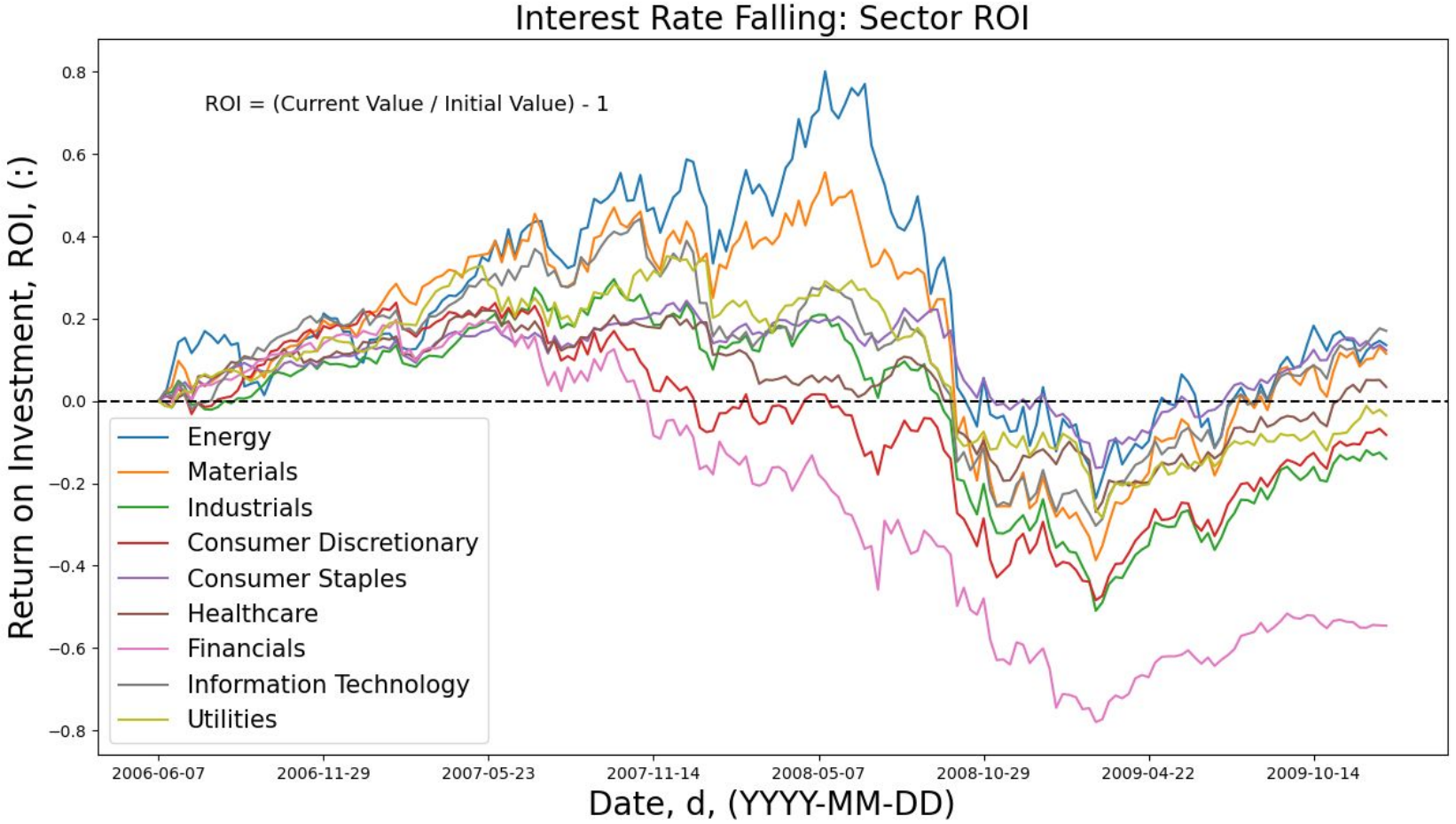


Data Exploration

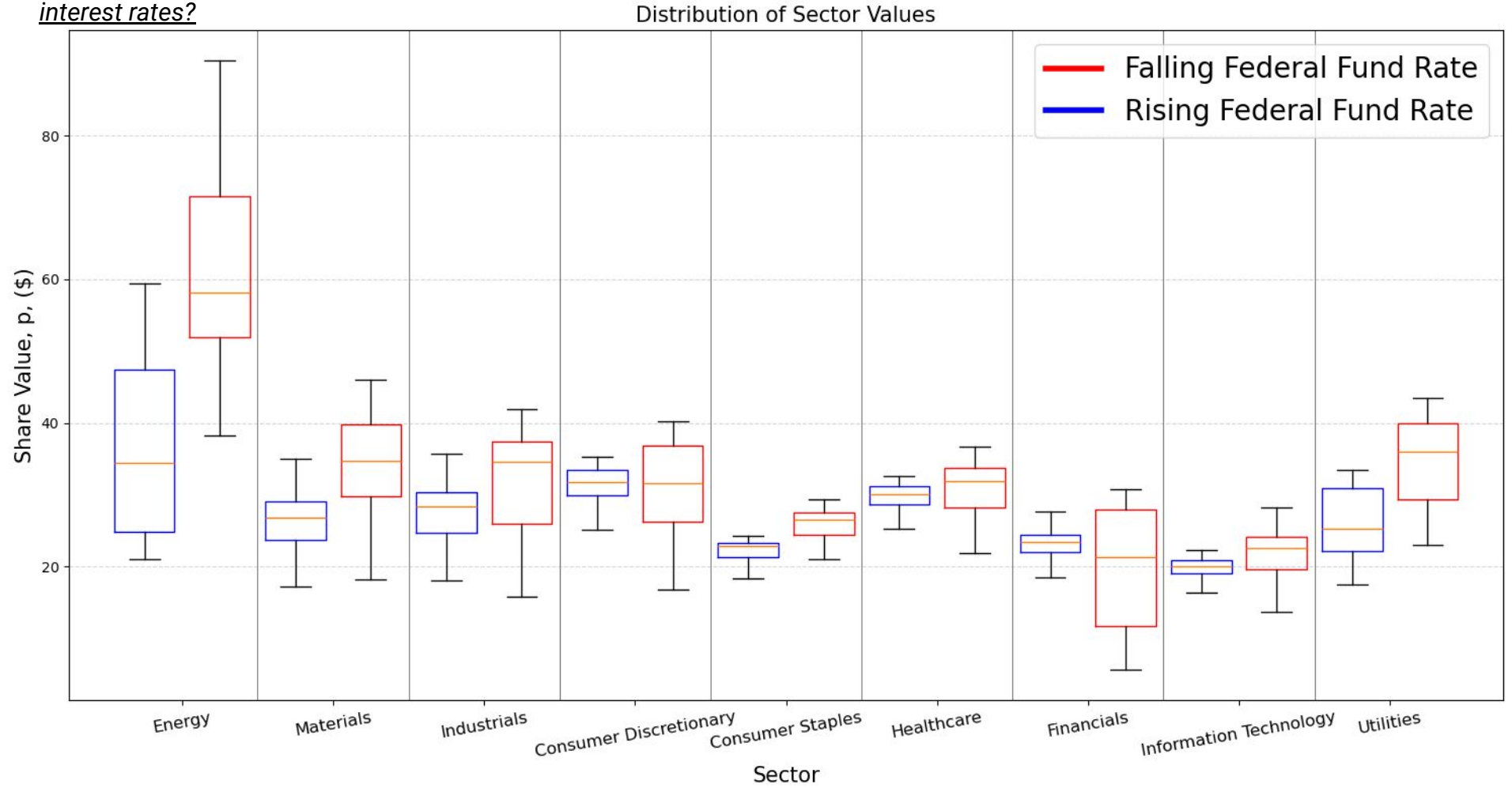
Which sectors are the highest/lowest performing in a rising interest rate environment as opposed to a Lowering interest rate environment?

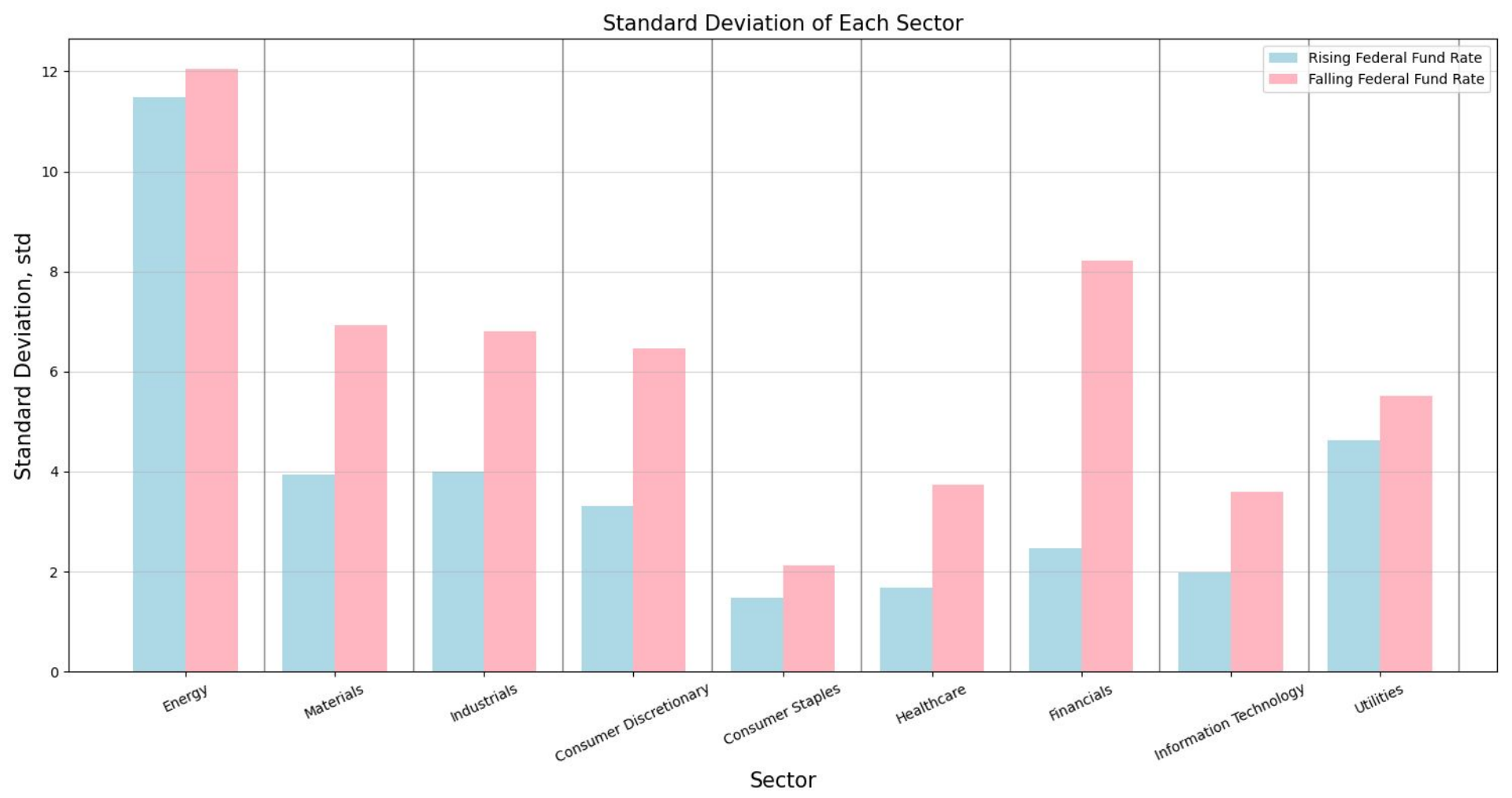


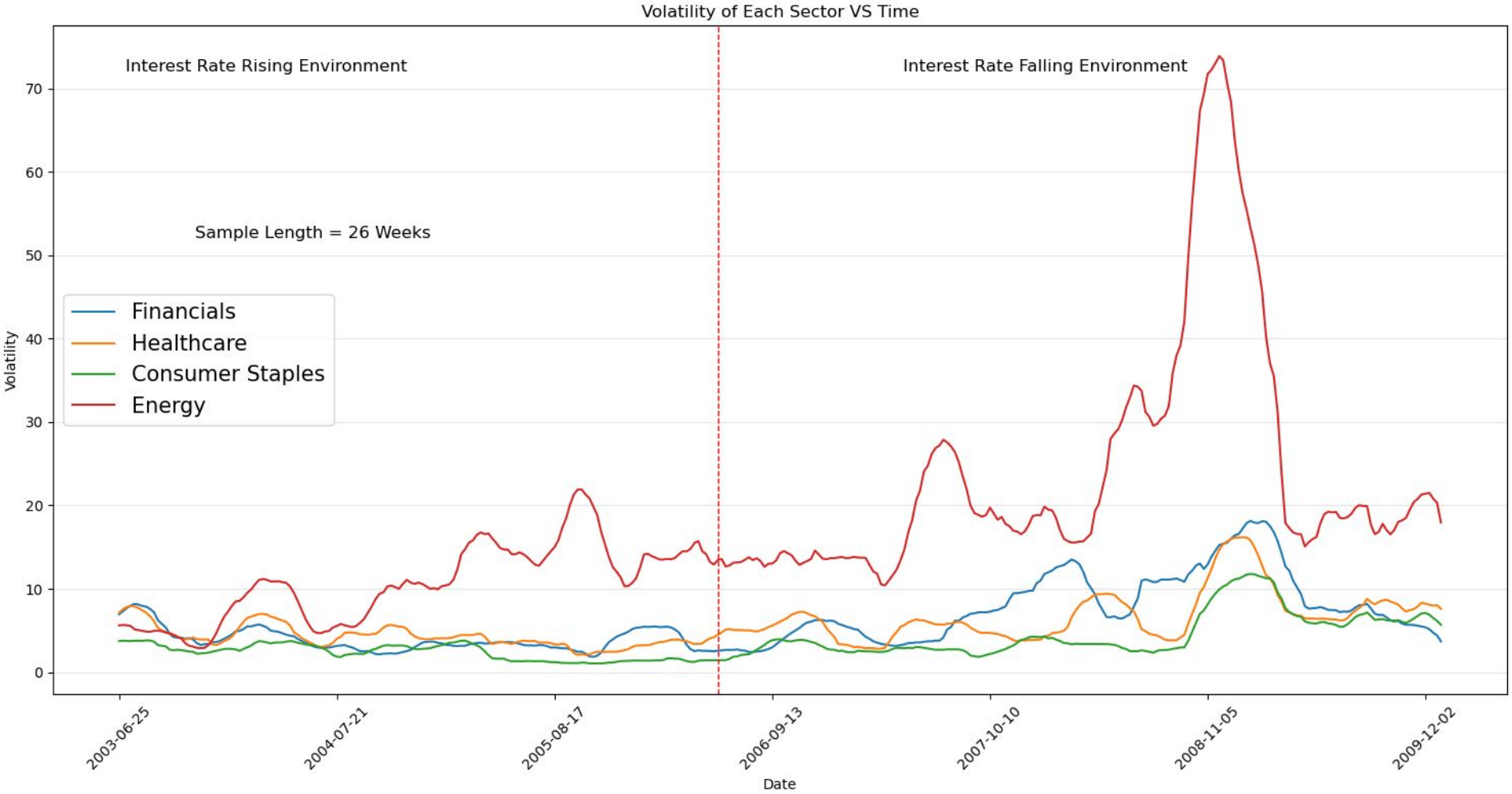

Interest Rate Rising: Sector ROI
Energy
Materials
Industrials
Consumer Discretionary
Consumer Staples
Healthcare
Financials
Information Technology
Utilities
ROI = (Current Value / Initial Value) - 1
Return on Investment, ROI, (:)
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
−0.25
2003-01-01
2003-06-25
2003-12-17
2004-06-09
2004-12-01
2005-05-25
2005-11-16
2006-05-10
Date, d, (YYYY-MM-DD)


Interest Rate Falling: Sector ROI
ROI = (Current Value / Initial Value) - 1
Return on Investment, ROI, (:)
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
Energy
Materials
Industrials
Consumer Discretionary
Consumer Staples
Healthcare
Financials
Information Technology
Utilities
2006-06-07
2006-11-29
2007-05-23
2007-11-14
2008-05-07
2008-10-29
2009-04-22
2009-10-14
Date, d, (YYYY-MM-DD)

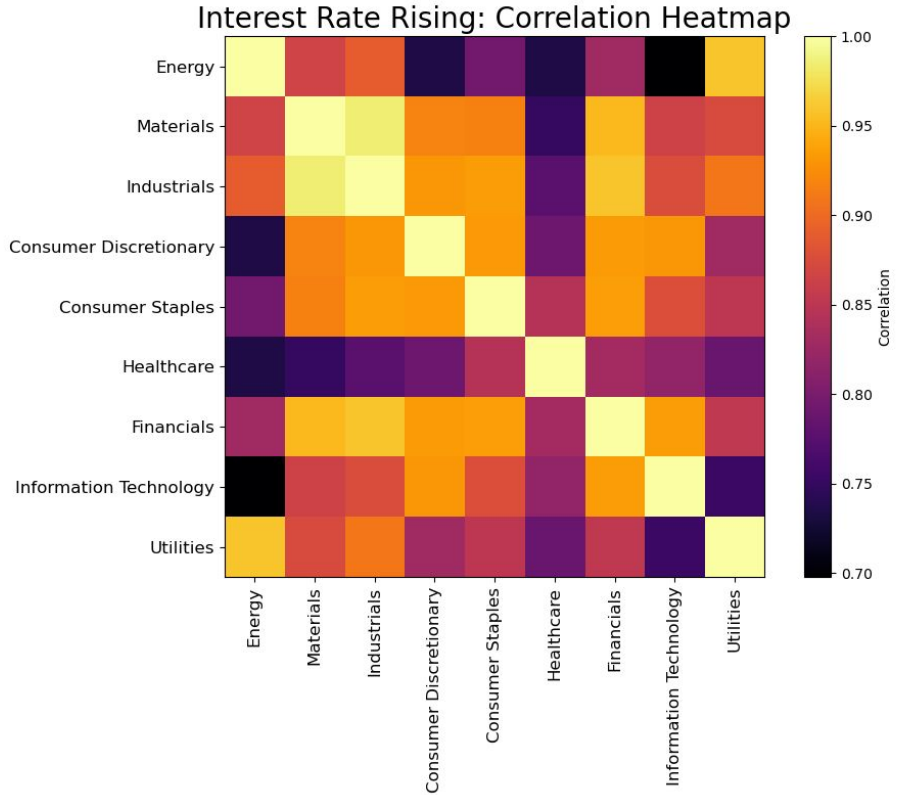
What observations can be made regarding sector volatility amidst shifts in interest rates between periods of rising and falling interest rates?

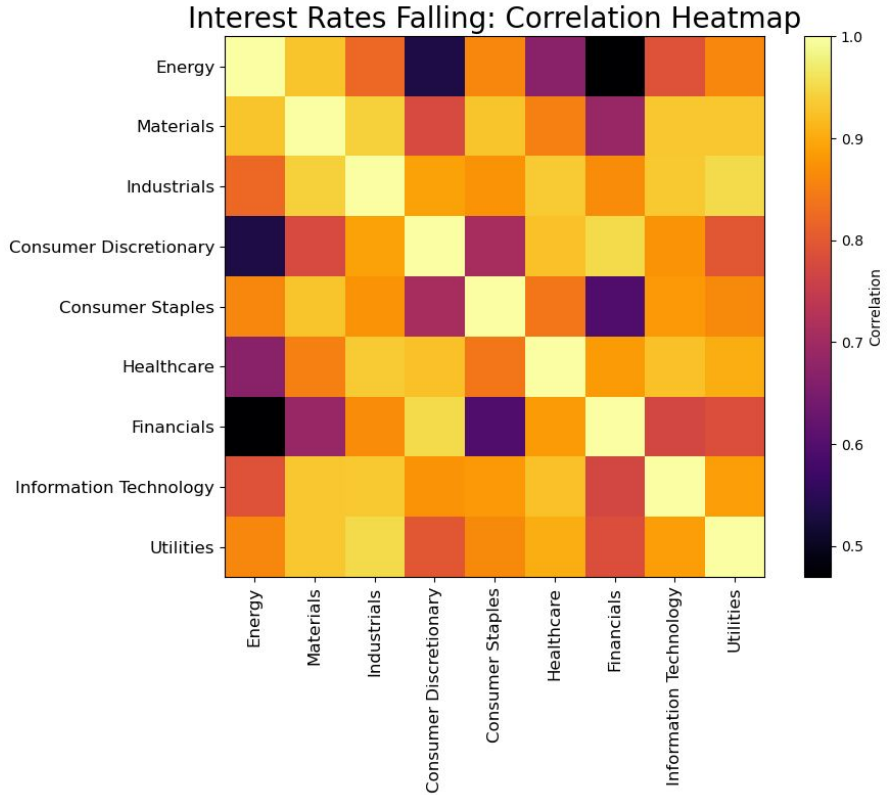



Standard Deviation of Each Sector
Rising Federal Fund Rate
Falling Federal Fund Rate
Standard Deviation, std
0
2
4
6
8
10
12
Energy
Materials
Industrials
Consumer Discretionary
Consumer Staples
Healthcare
Financials
Information Technology
Utilities
Sector


Volatility of Each Sector VS Time
Interest Rate Rising Environment
Interest Rate Falling Environment
Sample Length = 26 Weeks
Financials
Healthcare
Consumer Staples
Energy
Volatility
0
10
20
30
40
50
60
70
2003-06-25
2004-07-21
2005-08-17
2006-09-13
2007-10-10
2008-11-05
2009-12-02
Date

What correlations exist between sector performance during rising and falling interest rate environments, and how do these correlations vary across different phases of interest rate cycles?





CODE SNIPPETS:

```
# Calculate ROI for each column
roi_Total_df = df_Total_FEDFUND_Cycle / df_Total_FEDFUND_Cycle.iloc[0] - 1
```

Rolling Volatility Window HeatMap:

```
# Calculate volatility for each chosen sector.
# Use a window of time that rolls with the calculation.
window = 26 #Weeks ~ (6 months)
volatility = Sector volatility cut.rolling(window=window).std().iloc[window - 1:] * np.sqrt(window)
```

Correlation HeatMap:

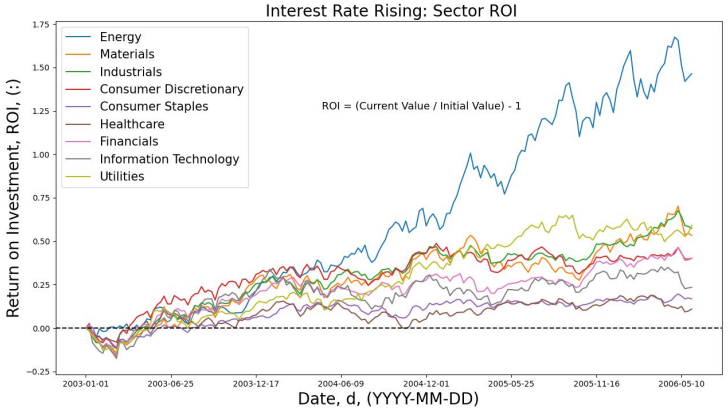
```
# Calculate the linear Correlation between all sectors.
Correlation_matrix_rising = df_Rising_FEDFUND.corr()
```

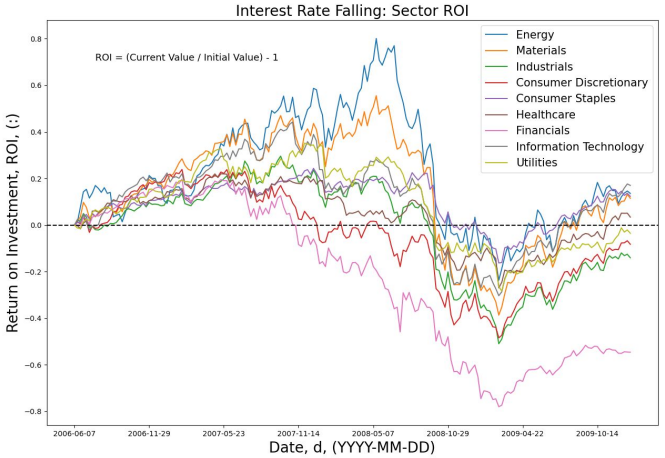
```
plt.imshow(Correlation_matrix_rising, cmap='inferno', interpolation='nearest')
```

Results & Conclusions

Question 1

Which sectors are the highest/lowest performing in a rising interest rate environment as opposed to a Lowering interest rate environment?



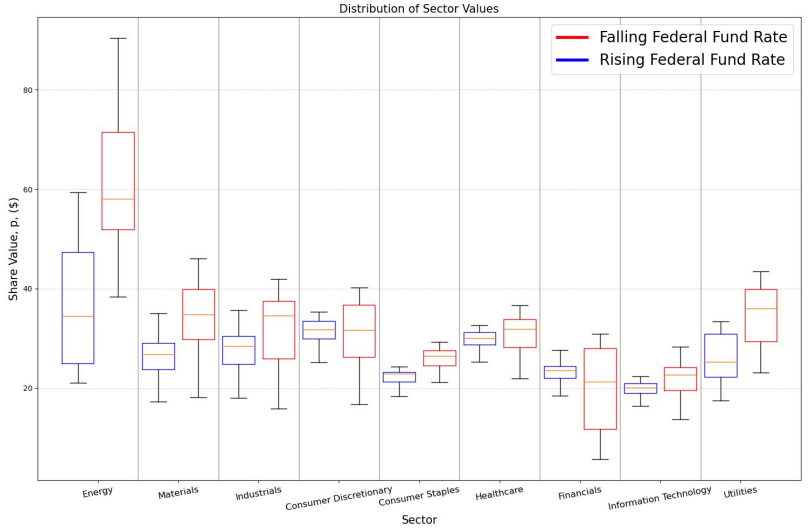


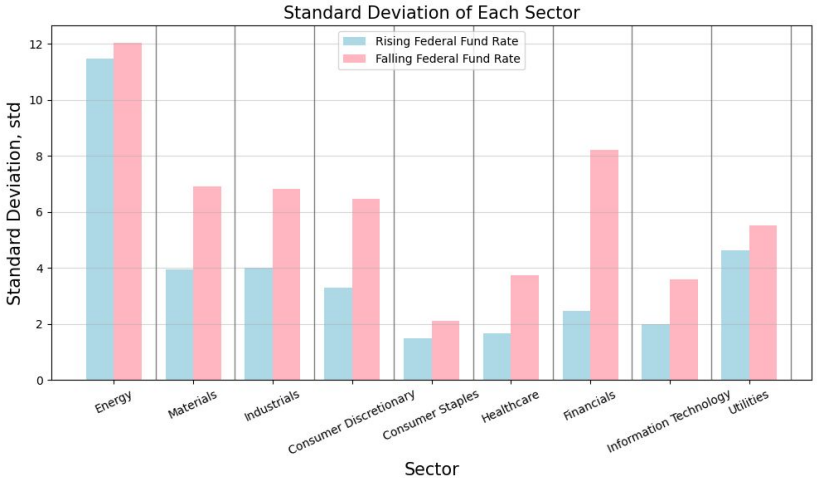
	Rising Interest rate Environment	Falling Interest rate Environment
Highest Performing Sector	Energy Utilities Industrials	Energy Consumer Staples Information Technology
Lowest Performing Sector	Healthcare Consumer Staples Information Technology	Financials Consumer- Discret Industrials

Question 2

What observations can be made regarding sector volatility amidst shifts in interest rates between periods of rising and falling interest rates?

	Rising Interest Rate Environment	Falling Interest Rate Environment
Most Volatile Sectors	Energy, Utilities, Industrials	Energy, Financials, Materials
Least Volatile Sectors	Health industry, Consumer Staples, Information Technology	Health Industry, Consumer Staples, Information Technology

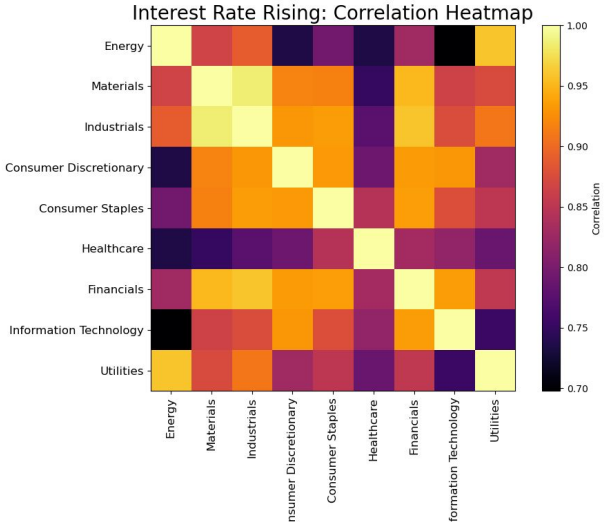


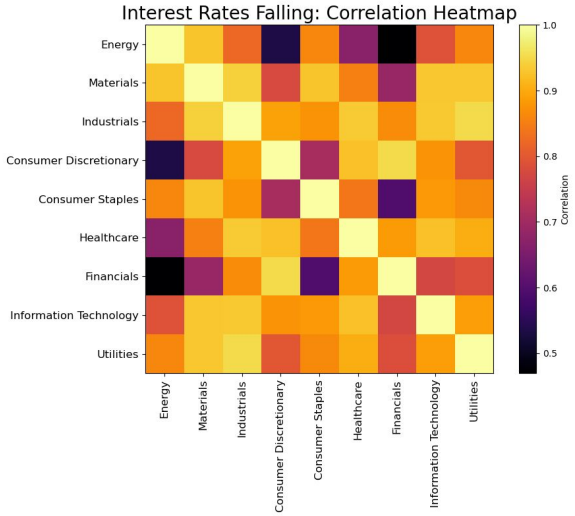


Question 3

What correlations exist between sector performance during rising and falling interest rate environments, and how do these correlations vary across different phases of interest rate cycles?

	Rising Interest rate Environment	Falling Interest rate Environment
Most Correlated Sectors	Financial, Industrial , Material	Energy, material , Industrial
Least Correlated Sectors	Consumer Staples, Utilities	Consumer Staples, Utilities





Next Steps

Avenues of Inquiry

- Build a Portfolio of stocks within each sector for different investor profiles and test its performance using the same interest rates
- Build a dashboard for a prospective investor to test what mix of stocks and sectors they would want in their portfolio and potential returns
- Test stock and sector performance against different economic indicators such CPI (Consumer Price Index) and GDP (Gross Domestic Product)

Technologies to Adopt

- SQL to build a Database
- HTML/CSS/Javascript to build Visualizations
- Tableau to create Dashboards
- Machine Learning to predict outcomes provided certain data points

FIN.