Correlation between changes in monetary policy and market performance.

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FIN377

WHY WE CHOSE THIS TOPIC?

- The FOMC's decisions on whether to raise or lower interest rates have far-reaching effects on the economy.

- We aim to provide a framework that allows investors to time their investments more effectively around the FOMC's scheduled meetings.

- Connection between the changes in interest rates brought on by FOMC meetings on the stock market and bonds.

DATASET

- Federal Open Market Committee (FOMC)

- S&P 500 - indicator for stock correlation

- Vanguard Intermdiate Long-Term Bond Index Fund (VBILX) -bond sample

- Vanguard Short-Term Bond Index Fund Admiral Shares (VBIRX) - bond sample

Data: From 2015 to 2023 daily market return data on days t-10 to t+10, where t represents

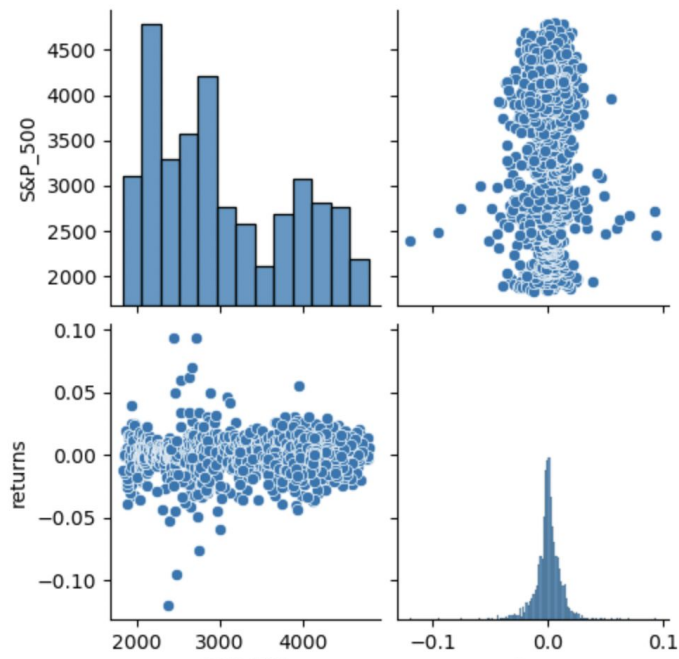the date of the reserve requirement change.

Hypothesis

We suspect that large increases in interest rates would lead to negative or lower returns in the days before and after an FOMC meeting and vice versa.

Methodology

1. Create Data Frame & EDA

- ■ Put each individual CSV into their own individual dataframes
- ■ **EDA:**
- ■ Describe()
- ■ Missing values
- ■ Convert object variables to numeric values
- ■ Outliers
- ■ visualizations
- ■ Dtype

2. Merged Individual Index DFs Together

```python
final_data = sp500_ret.merge(Vbilx,
            on=['Date'],
            how='left',
            validate='one_to_one')
```

```python
final_data2 = final_data.merge(Vbirx, on=['Date'],
            how='left',
            validate='one_to_one')
```

3. Create Dummy Variable

```python
fomc_rates
fomc_rates['Change'] = np.where(fomc_rates['Increase'] > 0,1,0)
```

4. Create Event Variable

```python
event_time_rets = (
    final_data2.merge(fomc_rates[['Date']], on = ["Date"], how = 'left',
                      validate = 'm:1', indicator = True)

    # create event flag, then use this to create event_id
    .assign(event = lambda x: (x['_merge'] == 'both').astype(int))
    .assign(event_id = lambda x: x['event'].cumsum(),
            date2 = lambda x: x['Date'])

    # reduce dataframe to [-10,+10] around event
    # event id starts 10 days before event and goes to 10 days after
    .assign(event_id = lambda x: x['event_id'].shift(-10))
    .query('event_id > 0')
    .groupby('event_id').head(20)

    # helper columns
    .assign(increment =lambda x: np.arange(len(x)),
            inc_at_e = lambda x: x['event']*x['increment'])

    #inc_at_e alwasy equal to increment # at firms event
    .assign(inc_at_e = lambda x: x.groupby('event_id')['inc_at_e'].transform(sum))

    #compute event time
    .assign(event_time = lambda x: x['increment'] -x['inc_at_e'])

    # clear out useless columns
    .drop(['_merge','date2','increment','inc_at_e'],axis=1)
    # .query('event_id == 13')
    # .iloc[:,-8:]

    .query('event_id != 13 & event_id != 14')
)
```

5. Merge in the FOMC Rate DF & . Create "Change" Variable

```python
# we need a new var = the date of the event so that we can merge in fomc_rate vars

# Create a new column 'date_when_var2_is_1' and set it to NaN initially
event_time_rets['event_id_date'] = np.nan

# Find the date from 'var1' when 'var2' is equal to 1 for each 'event_id'
date_when_var2_is_1 = event_time_rets[event_time_rets['event'] == 1].groupby('event_id')['Date'].first()

# Iterate through the unique event_ids and set the 'date_when_var2_is_1' value for each event_id
for event_id, date_value in date_when_var2_is_1.items():
    event_time_rets.loc[event_time_rets['event_id'] == event_id, 'event_id_date'] = date_value
```

```python
# now merge in fomc_rate date
event_time_rets = event_time_rets.merge(fomc_rates,
                        left_on = 'event_id_date',
                        right_on = 'Date',
                        how = 'left',
                        validate = 'm:1').drop('Date_y',axis=1)
```

```python
event_time_rets.eval('change = Increase - Decrease', inplace = True)
event_time_rets.eval('Increase = Increase > 0',inplace=True)
```

Cleaning and exploratory analysis

- We used the describe function to understand find count, mean, std, among other key factors.

- Missing values in the data; we found the missing data was minimum.

- Explored the outliers and discussed the findings.

- Pairplot to visualize the relationships between the variables in the dataset.

Analysis

|	Date_x	S&P_500	sp500_ret	VBLIX_daily_ret	VBILX_daily_price	VBIRX_daily_ret
1	2015-12-03	2049.62	-0.0143735783910634	-0.0078877316716358	9.156682968139648	-0.0019081971316328
2	2015-12-04	2091.69	0.0205257559937941	0.0017666030167438	9.172859191894531	0.0
3	2015-12-07	2077.07	-0.006989563463037	0.0026446076494732	9.197117805480955	0.0009557157450186
4	2015-12-08	2063.59	-0.0064899112692398	0.0	9.197117805480955	0.0
5	2015-12-09	2047.62	-0.0077389403902908	0.0008806624140893	9.205217361450195	0.0

event_id	event_time	event_id_date	Increase	change
1.0	-10	2015-12-17	True	25.0
1.0	-9	2015-12-17	True	25.0
1.0	-8	2015-12-17	True	25.0
1.0	-7	2015-12-17	True	25.0
1.0	-6	2015-12-17	True	25.0

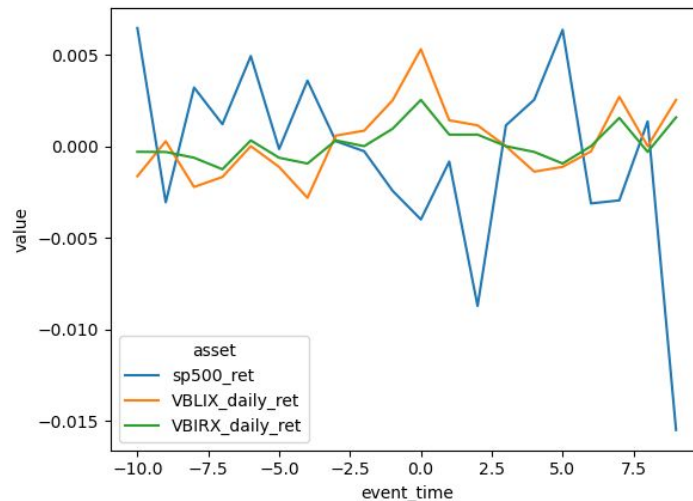# Correlation Matrix

Data with rates
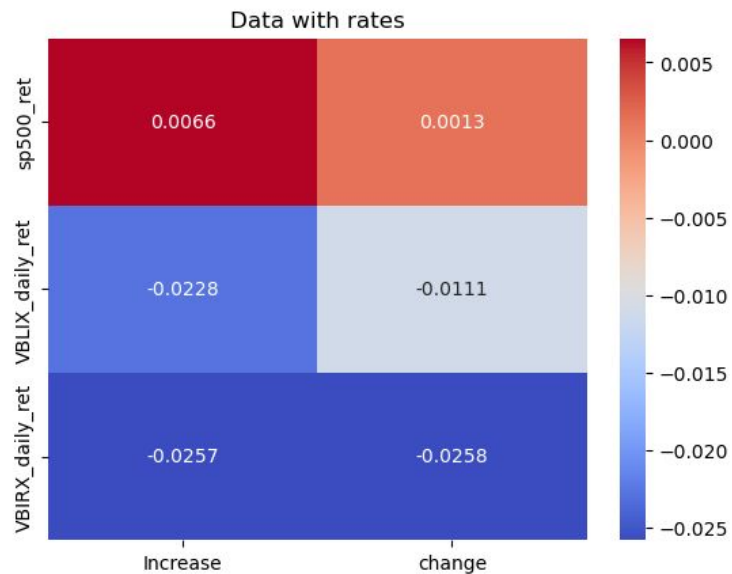
- Confusing correlation between rate increases and sp500 index
- Both the VBLIX and VBLAX correlations align with common assumptions about bond prices
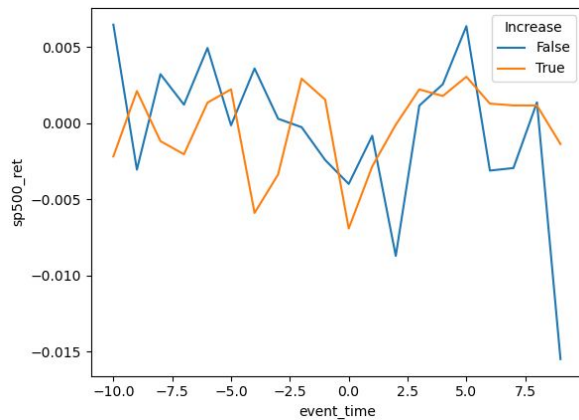
Increase vs Decrease on Indexes
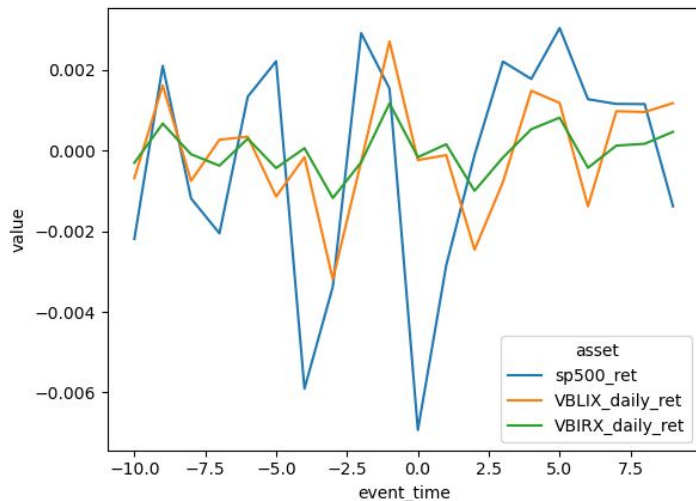
Increase

Shows similar findings to the correlation matrix:
increase in rate = lower bond prices
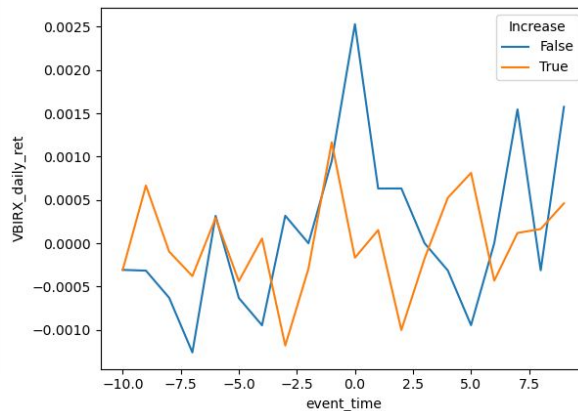Super volatile in surrounding days

Decrease

sp500 returns make more sense in this graph
inverse of last graph in terms of bonds
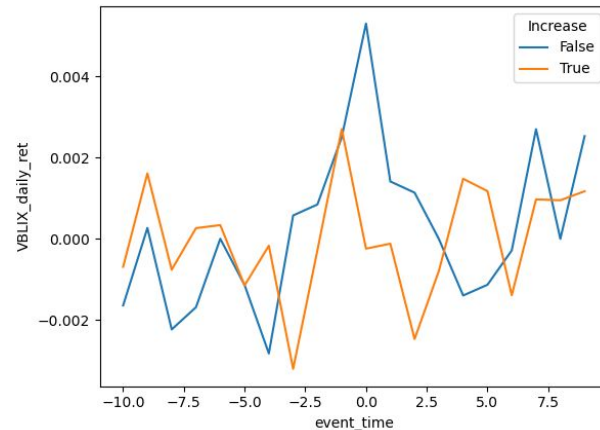Slightly less volatile in surrounding days

Index Reponses to Increase vs Decrease

S&P 500　　　　　VBIRX　　　　　VBLIX

Conclusions

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- The correlations between the rate hikes and returns were not as clear cut as expected

- S&P 500 experienced significantly more volatility in the periods we studied than the two bond indexes

- Predicting FOMC decisions is more difficult than expected- investors having trouble timing the market

- Different methods could be used to further the study (implementing a categorical variable, seasonality)

Sources

DATASET

- https://www.federalreserve.gov/monetarypolicy/openmarket.htm

- https://www.spglobal.com/spdji/en/indices/equity/sp-500/#overview

- https://ycharts.com/indicators/cboe_spx_volume

Questions?