josh_work

January 31, 2026

Question 1

a. The last datapoint was released on 26/09/2025.

b. The month being measured was August, 2025.

c. The series is now indexing the latest release as 30/11/2025.

d. The changes in the dates change forecasts by creating lookahead bias. If a forecaster uses data that was not available at the indexed time to train a model, the model will have an unfair advantage and will likely not perform as well in the future.

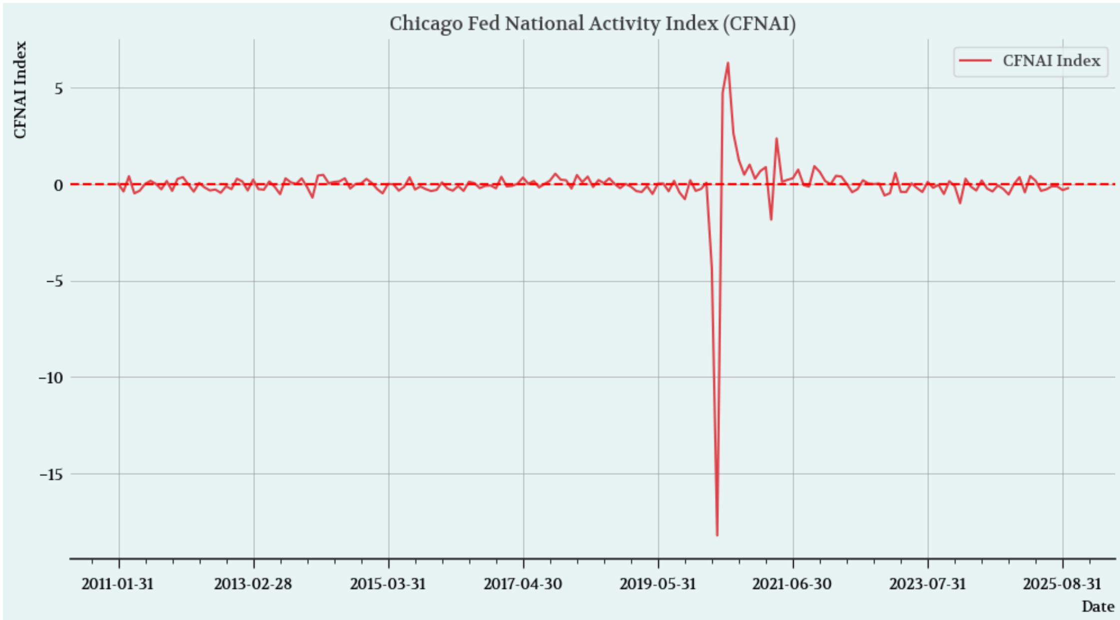
Question 2

[139]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import statsmodels.api as sm
import morethemes as mt
mt.set_theme('economist')
import warnings
warnings.filterwarnings('ignore')
```

[140]:
```
df = pd.read_csv('data.csv')
df.set_index('Date', inplace=True)
```

Part a.

[141]:
```
#GitHub Copilot suggested the labels and title
df.plot(y='CFNAI Index', figsize=(12,6))
plt.title('Chicago Fed National Activity Index (CFNAI)')
plt.xlabel('Date')
plt.ylabel('CFNAI Index')
plt.axhline(0, color='red', linestyle='--')
plt.show()
```



Part b. It makes sense to use the CFNAI as a proxy for the output gap because it indicates whether economic activity is above or below its long-run trend. Since potential output is unobservable in real time, CFNAI provides a way to capture deviations from trend. Negative values indicate a negative output gap and positive values indicate a positive one.

Question 3

Part c.

[142]:
```
df['Inflation Gap'] = df['PCE CYOY Index'] - 2.0
```

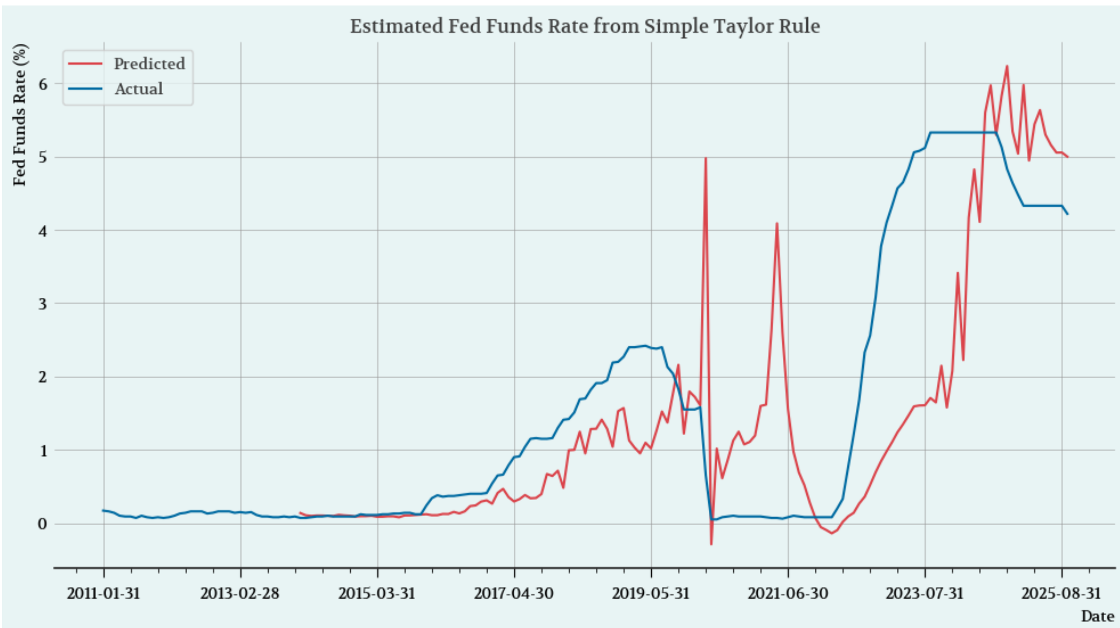
Part b.

[ ]:
```
window = 36

y = df["fedfunds"].astype(float)

X = df[["CFNAI Index", "Inflation Gap"]].astype(float)
X = sm.add_constant(X)

pred = pd.Series(np.nan, index=df.index, dtype=float)

for t in range(window, len(df)):
    y_train = y.iloc[t - window : t]
    X_train = X.iloc[t - window : t]
    train = pd.concat([y_train, X_train], axis=1).dropna()
    model = sm.OLS(train.iloc[:, 0], train.iloc[:, 1:]).fit()
    pred.iloc[t] = model.predict(X.iloc[t : t + 1])[0]
```

```
df["Fed Funds"] = pred
```

Part c.

[151]:
```
#GitHub Copilot suggested labels and title
df.plot(y=['Fed Funds', 'fedfunds'], figsize=(12,6))
plt.title('Estimated Fed Funds Rate from Simple Taylor Rule')
plt.xlabel('Date')
plt.ylabel('Fed Funds Rate (%)')
plt.legend(['Predicted', 'Actual'])
plt.show()
```



Question 4

Part a.

[145]:
```
# Trading strategy: long SHY if predicted Fed Funds > observed, short otherwise
predicted_col = 'Fed Funds'
observed_col = 'fedfunds'
price_col = 'SHY US Equity'

signal = np.where(df[predicted_col] > df[observed_col], 1, -1)

# One-period holding: apply signal at t to return from t-1 to t
shy_ret = df[price_col].pct_change()
strategy_ret = pd.Series(signal, index=df.index).shift(1) * shy_ret
```

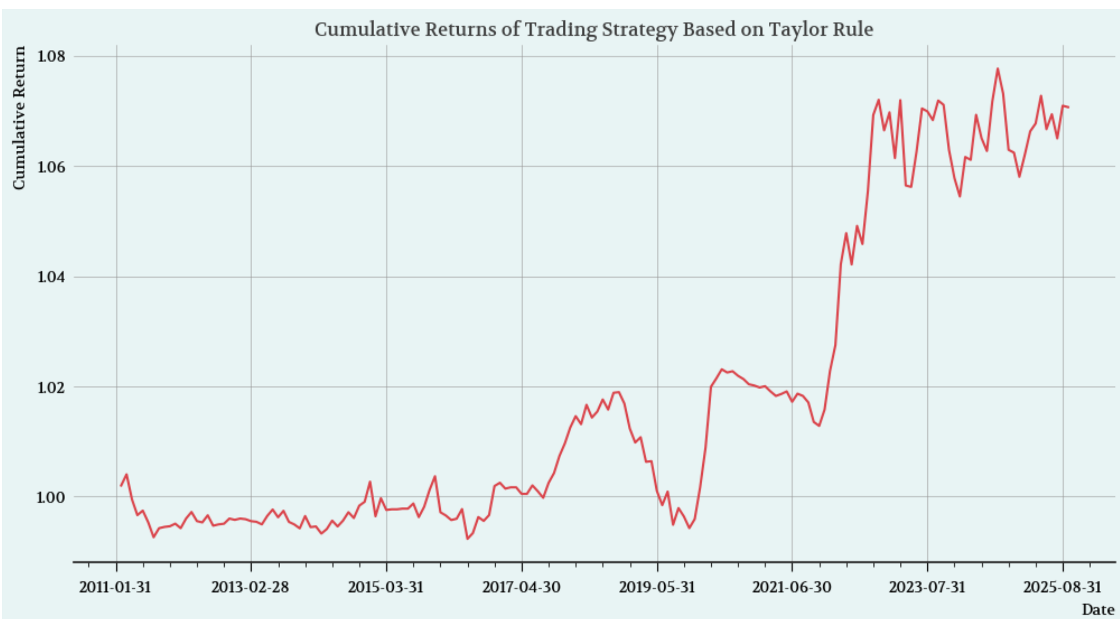
```python
strategy = pd.DataFrame({
    'signal': signal,
    'shy_ret': shy_ret,
    'strategy_ret': strategy_ret
}, index=df.index)

strategy.head(10)
```

[145]:

Date	signal	shy_ret	strategy_ret
2011-01-31	-1	NaN	NaN
2011-02-28	-1	-0.002022	0.002022
2011-03-31	-1	-0.002026	0.002026
2011-04-30	-1	0.004537	-0.004537
2011-05-31	-1	0.002853	-0.002853
2011-06-30	-1	-0.000830	0.000830
2011-07-31	-1	0.002135	-0.002135
2011-08-31	-1	0.002723	-0.002723
2011-09-30	-1	-0.001653	0.001653
2011-10-31	-1	-0.000236	0.000236

Part c.

[146]:
```python
#GitHub Copilot suggested labels and title
(strategy['strategy_ret'] + 1).cumprod().plot(figsize=(12,6))
plt.title('Cumulative Returns of Trading Strategy Based on Taylor Rule')
plt.xlabel('Date')
plt.ylabel('Cumulative Return')
plt.show()
```



Part c.

[147]:
```
#GitHub Copilot was used for Dataframe formatting
period_return = (strategy['strategy_ret'] + 1).prod() - 1
start_date = pd.to_datetime(strategy.index[0])
end_date = pd.to_datetime(strategy.index[-1])
years = (end_date - start_date).days / 365.25
annualized_return = (1 + period_return) ** (1 / years) - 1

annualized_df = pd.DataFrame({
    'Metric': ['Annualized Return'],
    'Value': [f'{annualized_return:.2%}']
})
annualized_df.style.hide(axis='index')
```

[147]:
```
<pandas.io.formats.style.Styler at 0x3165dac10>
```

Part d.

[148]:
```
#GitHub Copilot was used for Dataframe formatting
skewness_value = strategy['strategy_ret'].skew()

skewness_df = pd.DataFrame({
    'Metric': ['Skew'],
    'Value': [skewness_value]
})
skewness_df.style.hide(axis='index')
```

[148]:
```
<pandas.io.formats.style.Styler at 0x3165da990>
```

The Taylor-rule predictions overestimate the federal funds rate in the post-COVID period because the rolling window includes the rapid inflation surge and aggressive tightening cycle. This leads the model to predict a more aggressive policy reaction than the Fed did in reality.