

# asset-class-performance-fed-policy-cycles

December 2, 2025

## 1 Performance Of Various Asset Classes During Fed Policy Cycles

### 1.1 Python Imports

```
[1]: # Standard Library
import datetime
import io
import os
import random
import sys
import warnings

from datetime import datetime, timedelta
from pathlib import Path

# Data Handling
import numpy as np
import pandas as pd

# Data Visualization
import matplotlib.dates as mdates
import matplotlib.pyplot as plt
import matplotlib.ticker as mtick
import seaborn as sns
from matplotlib.ticker import FormatStrFormatter, FuncFormatter, MultipleLocator

# Data Sources
import yfinance as yf
import pandas_datareader.data as web

# Statistical Analysis
import statsmodels.api as sm

# Machine Learning
from sklearn.decomposition import PCA
from sklearn.preprocessing import StandardScaler

# Suppress warnings
```

```
warnings.filterwarnings("ignore")
```

## 1.2 Add Directories To Path

```
[2]: # Add the source subdirectory to the system path to allow import config from
      ↪settings.py
current_directory = Path(os.getcwd())
website_base_directory = current_directory.parent.parent.parent
src_directory = website_base_directory / "src"
sys.path.append(str(src_directory)) if str(src_directory) not in sys.path else
      ↪None

# Import settings.py
from settings import config

# Add configured directories from config to path
SOURCE_DIR = config("SOURCE_DIR")
sys.path.append(str(Path(SOURCE_DIR))) if str(Path(SOURCE_DIR)) not in sys.path else
      ↪None

# Add other configured directories
BASE_DIR = config("BASE_DIR")
CONTENT_DIR = config("CONTENT_DIR")
POSTS_DIR = config("POSTS_DIR")
PAGES_DIR = config("PAGES_DIR")
PUBLIC_DIR = config("PUBLIC_DIR")
SOURCE_DIR = config("SOURCE_DIR")
DATA_DIR = config("DATA_DIR")
DATA_MANUAL_DIR = config("DATA_MANUAL_DIR")

# Print system path
for i, path in enumerate(sys.path):
    print(f"{i}: {path}")
```

```
0: /usr/lib/python313.zip
1: /usr/lib/python3.13
2: /usr/lib/python3.13/lib-dynload
3:
4: /home/jared/python-virtual-envs/general_313/lib/python3.13/site-packages
5: /home/jared/python-virtual-envs/general_313/lib/python3.13/site-
packages/setuptools/_vendor
6: /home/jared/Cloud_Storage/Dropbox/Websites/jaredszajkowski.github.io/src
```

### 1.3 Track Index Dependencies

```
[3]: # Create file to track markdown dependencies  
dep_file = Path("index_dep.txt")  
dep_file.write_text("")
```

```
[3]: 0
```

### 1.4 Python Functions

```
[4]: from calc_fed_cycle_asset_performance import calc_fed_cycle_asset_performance  
from df_info import df_info  
from df_info_markdown import df_info_markdown  
from export_track_md_deps import export_track_md_deps  
from load_data import load_data  
from pandas_set_decimal_places import pandas_set_decimal_places  
from plot_bar_returns_ffr_change import plot_bar_returns_ffr_change  
from plot_timeseries import plot_timeseries  
from plot_scatter_regression_ffr_vs_returns import  
    plot_scatter_regression_ffr_vs_returns  
from sm_ols_summary_markdown import sm_ols_summary_markdown  
from summary_stats import summary_stats  
from yf_pull_data import yf_pull_data
```

### 1.5 Data Overview

```
[5]: # Set timeframe  
start_date = "2004-11-30" # GLD inception (month end)  
end_date = "2025-10-31"
```

#### 1.5.1 Acquire & Plot Fed Funds Data

```
[6]: # Set decimal places  
pandas_set_decimal_places(4)  
  
# Pull Effective Fed Funds Rate from FRED  
fedfunds = web.DataReader("FEDFUNDS", "fred", start="1900-01-01", end=datetime.  
    today())  
fedfunds["FEDFUNDS"] = fedfunds["FEDFUNDS"] / 100 # Convert to decimal  
  
# Resample to monthly frequency and compute change in rate  
fedfunds_monthly = fedfunds.resample("M").last()  
fedfunds_monthly = fedfunds_monthly[(fedfunds_monthly.index >= pd.  
    to_datetime(start_date)) & (fedfunds_monthly.index <= pd.  
    to_datetime(end_date))]  
fedfunds_monthly["FedFunds_Change"] = fedfunds_monthly["FEDFUNDS"].diff()
```

```
[7]: df_info(fedfunds_monthly)
```

The columns, shape, and data types are:  
<class 'pandas.core.frame.DataFrame'>  
DatetimeIndex: 252 entries, 2004-11-30 to 2025-10-31  
Freq: ME  
Data columns (total 2 columns):  
 # Column Non-Null Count Dtype  
---  
 0 FEDFUNDS 252 non-null float64  
 1 FedFunds\_Change 251 non-null float64  
dtypes: float64(2)  
memory usage: 5.9 KB  
None  
The first 5 rows are:

	FEDFUNDS	FedFunds_Change
DATE		
2004-11-30	0.0193	NaN
2004-12-31	0.0216	0.0023
2005-01-31	0.0228	0.0012
2005-02-28	0.0250	0.0022
2005-03-31	0.0263	0.0013

The last 5 rows are:

	FEDFUNDS	FedFunds_Change
DATE		
2025-06-30	0.0433	0.0000
2025-07-31	0.0433	0.0000
2025-08-31	0.0433	0.0000
2025-09-30	0.0422	-0.0011
2025-10-31	0.0409	-0.0013

```
[8]: # Copy this <!-- INSERT_01_Fed_Funds_Monthly_Rate_Change_HERE --> to index_temp.  
      ↵md  
      export_track_md_deps(dep_file=dep_file, ↵  
      ↵md_filename="01_Fed_Funds_Monthly_Rate_Change.md", ↵  
      ↵content=df_info_markdown(df=fedfunds_monthly, decimal_places=4))
```

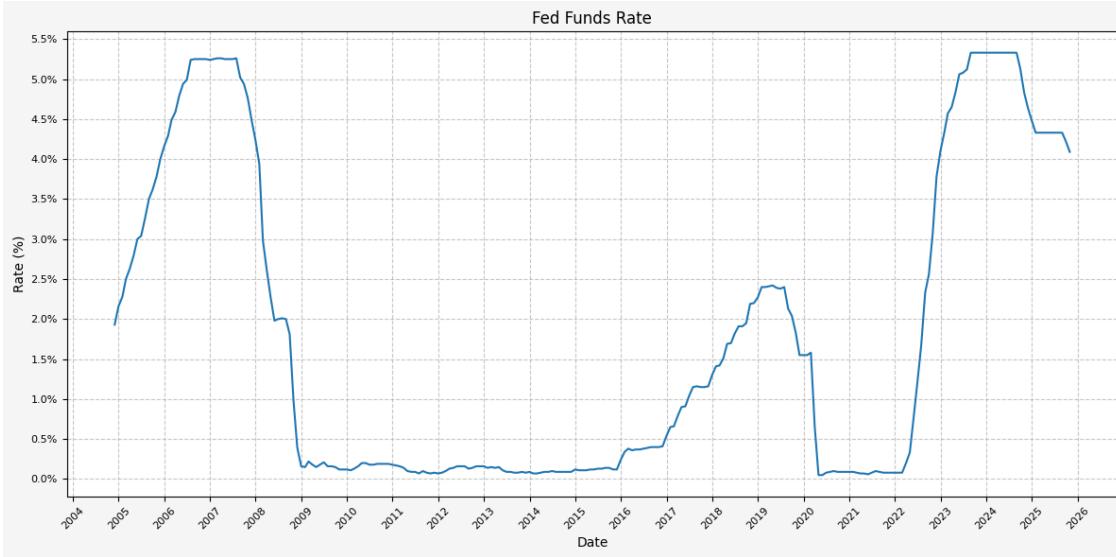
Exported and tracked: 01\_Fed\_Funds\_Monthly\_Rate\_Change.md

```
[9]: plot_timeseries(  
    price_df=fedfunds_monthly,  
    plot_start_date=start_date,  
    plot_end_date=end_date,  
    plot_columns=["FEDFUNDS"],  
    title="Fed Funds Rate",  
    x_label="Date",
```

```

x_format="Year",
y_label="Rate (%)",
y_format="Percentage",
y_format_decimal_places=1,
y_tick_spacing=0.005,
grid=True,
legend=False,
export_plot=True,
plot_file_name="01_Fed_Funds_Rate",
)

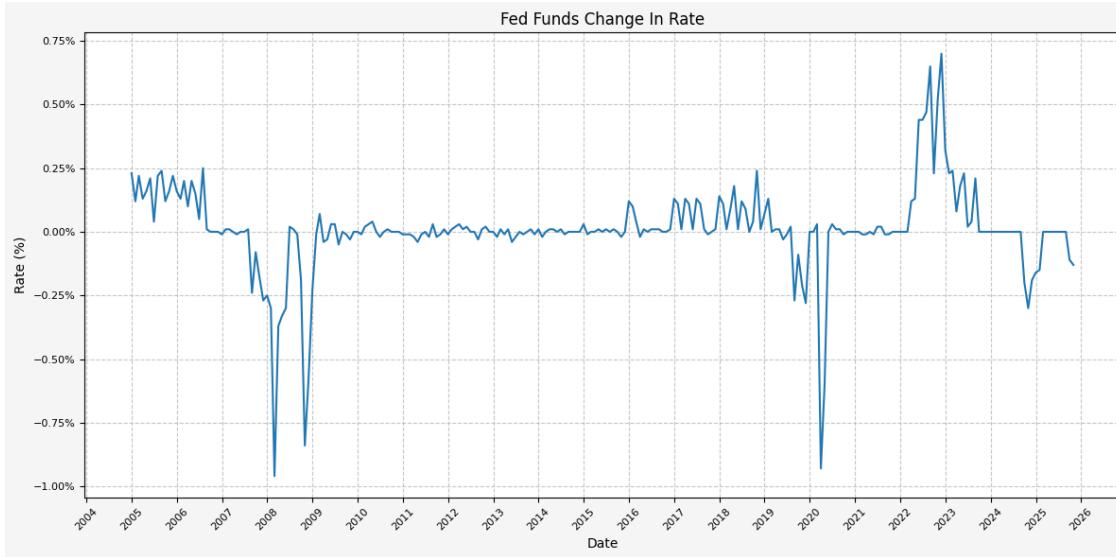
```



```

[10]: plot_timeseries(
    price_df=fedfunds_monthly,
    plot_start_date=start_date,
    plot_end_date=end_date,
    plot_columns=["FedFunds_Change"],
    title="Fed Funds Change In Rate",
    x_label="Date",
    x_format="Year",
    y_label="Rate (%)",
    y_format="Percentage",
    y_format_decimal_places=2,
    y_tick_spacing=0.0025,
    grid=True,
    legend=False,
    export_plot=True,
    plot_file_name="01_Fed_Funds_Change_In_Rate",
)

```



### 1.5.2 Define Fed Policy Cycles

```
[11]: # # Define manually specified Fed policy cycles
# fed_cycles = [
#     # ("2002-01-01", "2003-07-01"),
#     # ("2003-07-01", "2004-06-01"),
#     # ("2004-06-01", "2006-07-01"),
#     ("2004-11-01", "2006-07-01"),
#     ("2006-07-01", "2007-07-01"),
#     ("2007-07-01", "2008-12-01"),
#     ("2008-12-01", "2015-11-01"),
#     ("2015-11-01", "2019-01-01"),
#     ("2019-01-01", "2019-07-01"),
#     ("2019-07-01", "2020-04-01"),
#     ("2020-04-01", "2022-02-01"),
#     ("2022-02-01", "2023-08-01"),
#     ("2023-08-01", "2024-08-01"),
#     ("2024-08-01", datetime.today().strftime('%Y-%m-%d')),
# ]
#
# # Optional: assign a name to each cycle
# cycle_labels = [f"Cycle {i+1}" for i in range(len(fed_cycles))]
```

```
[12]: # Define manually specified Fed policy cycles
fed_cycles = [
    ("2004-11-01", "2006-07-01"),
    ("2006-07-01", "2007-07-01"),
    ("2007-07-01", "2008-12-01"),
```

```

("2008-12-01", "2015-11-01"),
("2015-11-01", "2019-01-01"),
("2019-01-01", "2019-07-01"),
("2019-07-01", "2020-04-01"),
("2020-04-01", "2022-02-01"),
("2022-02-01", "2023-08-01"),
("2023-08-01", "2024-08-01"),
("2024-08-01", datetime.today().strftime('%Y-%m-%d')),
]

# Optional: assign a name to each cycle
cycle_labels = [f"Cycle {i+1}" for i in range(len(fed_cycles))]
```

```
[13]: # Set decimal places
pandas_set_decimal_places(4)

# Calc changes by fed cycle defined above
fed_changes = []

for (start, end) in fed_cycles:
    start = pd.to_datetime(start)
    end = pd.to_datetime(end)

    try:
        rate_start = fedfunds.loc[start, "FEDFUNDS"]
    except KeyError:
        rate_start = fedfunds.loc[:start].iloc[-1]["FEDFUNDS"]

    try:
        rate_end = fedfunds.loc[end, "FEDFUNDS"]
    except KeyError:
        rate_end = fedfunds.loc[:end].iloc[-1]["FEDFUNDS"]

    change = rate_end - rate_start
    fed_changes.append(change)

fed_changes_df = pd.DataFrame({
    "Cycle": cycle_labels,
    "FedFunds_Change": fed_changes
})
```

fed\_changes\_df

```
[13]:   Cycle  FedFunds_Change
0    Cycle 1      0.0331
1    Cycle 2      0.0002
2    Cycle 3     -0.0510
```

```

3   Cycle 4           -0.0004
4   Cycle 5           0.0228
5   Cycle 6           0.0000
6   Cycle 7           -0.0235
7   Cycle 8           0.0003
8   Cycle 9           0.0525
9   Cycle 10          0.0000
10  Cycle 11          -0.0145

```

```
[14]: # Copy this <!-- INSERT_01_Fed_Funds_Cycle_Change_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file, md_filename="01_Fed_Funds_Cycle_Change.
˓→md", content=fed_changes_df.to_markdown(floatfmt=".4f"))
```

Exported and tracked: 01\_Fed\_Funds\_Cycle\_Change.md

## 1.6 Return Performance By Fed Policy Cycle

### 1.6.1 Stocks (SPY)

```
[15]: # Set decimal places
pandas_set_decimal_places(2)

yf_pull_data(
    base_directory=DATA_DIR,
    ticker="SPY",
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    excel_export=True,
    pickle_export=True,
    output_confirmation=True,
)
```

[\*\*\*\*\*100%\*\*\*\*\*] 1 of 1 completed

The first and last date of data for SPY is:

	Close	High	Low	Open	Volume
Date					
1993-01-29	24.31	24.33	24.21	24.33	1003200
	Close	High	Low	Open	Volume
Date					
2025-12-01	680.27	682.99	678.74	678.81	61201200

Yahoo Finance data complete for SPY

-----

```
[15]:             Close   High    Low   Open   Volume
Date
```

```

1993-01-29  24.31  24.33  24.21  24.33   1003200
1993-02-01  24.49  24.49  24.33  24.33    480500
1993-02-02  24.54  24.56  24.42  24.47   201300
1993-02-03  24.80  24.81  24.56  24.57   529400
1993-02-04  24.90  24.95  24.61  24.88   531500
...
2025-11-24  668.73 670.06 661.59 662.69  80437900
2025-11-25  675.02 676.21 664.48 668.63  81077100
2025-11-26  679.68 681.70 676.72 677.63  71879600
2025-11-28  683.39 683.67 680.50 680.86  49212000
2025-12-01  680.27 682.99 678.74 678.81  61201200

```

[8267 rows x 5 columns]

```

[16]: spy = load_data(
    base_directory=DATA_DIR,
    ticker="SPY",
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    timeframe="Daily",
    file_format="pickle",
)

# Filter SPY to date range
spy = spy[(spy.index >= pd.to_datetime(start_date)) & (spy.index <= pd.
    to_datetime(end_date))]

# Resample to monthly frequency
spy_monthly = spy.resample("M").last()
spy_monthly["Monthly_Return"] = spy_monthly["Close"].pct_change()

```

```
[17]: df_info(spy_monthly)
```

The columns, shape, and data types are:

```

<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 252 entries, 2004-11-30 to 2025-10-31
Freq: ME
Data columns (total 6 columns):
 #  Column          Non-Null Count  Dtype  
--- 
 0  Close           252 non-null    float64
 1  High            252 non-null    float64
 2  Low             252 non-null    float64
 3  Open            252 non-null    float64
 4  Volume          252 non-null    int64  
 5  Monthly_Return  251 non-null    float64
dtypes: float64(5), int64(1)
memory usage: 13.8 KB

```

```
None
```

```
The first 5 rows are:
```

Date	Close	High	Low	Open	Volume	Monthly_Return
2004-11-30	79.83	80.07	79.66	79.90	53685200	NaN
2004-12-31	82.23	82.77	82.19	82.53	28648800	0.03
2005-01-31	80.39	80.45	80.08	80.25	52532700	-0.02
2005-02-28	82.07	82.53	81.67	82.43	69381300	0.02
2005-03-31	80.57	80.91	80.51	80.73	64575400	-0.02

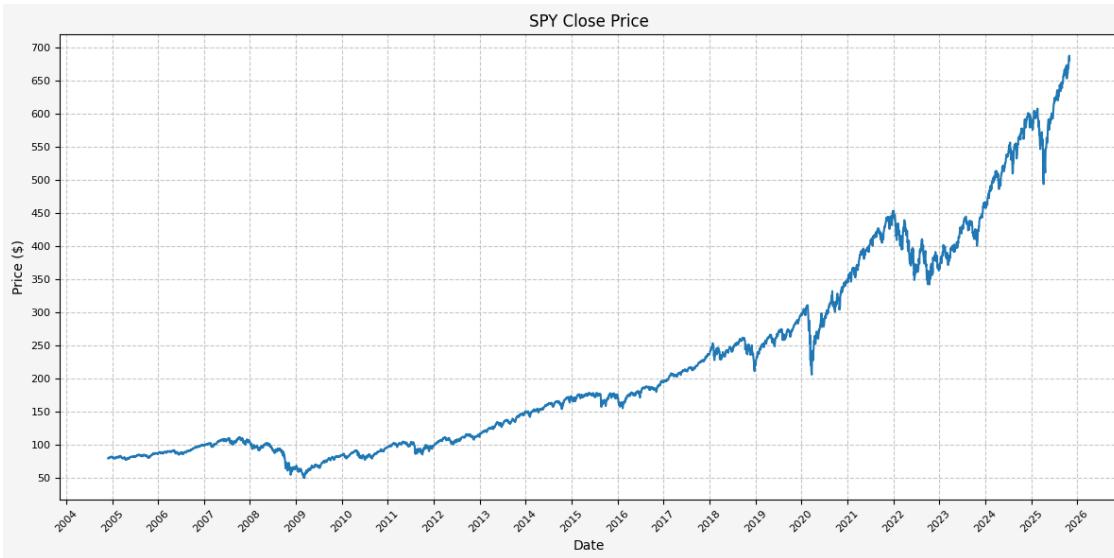
```
The last 5 rows are:
```

Date	Close	High	Low	Open	Volume	Monthly_Return
2025-06-30	616.14	617.51	613.34	615.67	92502500	0.05
2025-07-31	630.33	638.08	629.03	637.69	103385200	0.02
2025-08-31	643.27	646.05	641.36	645.68	74522200	0.02
2025-09-30	666.18	666.65	661.61	662.93	86288000	0.04
2025-10-31	682.06	685.08	679.24	685.04	87164100	0.02

```
[18]: # Copy this <!-- INSERT_02_SPY_Monthly_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file, md_filename="02_SPY_Monthly.md",
                     content=df_info_markdown(df=spy_monthly, decimal_places=2))
```

Exported and tracked: 02\_SPY\_Monthly.md

```
[19]: plot_timeseries(
    price_df=spy,
    plot_start_date=start_date,
    plot_end_date=end_date,
    plot_columns=["Close"],
    title="SPY Close Price",
    x_label="Date",
    x_format="Year",
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing=50,
    grid=True,
    legend=False,
    export_plot=True,
    plot_file_name="02_SPY_Price",
)
```



```
[20]: spy_cycle_df = calc_fed_cycle_asset_performance(
    fed_cycles=fed_cycles,
    cycle_labels=cycle_labels,
    fed_changes=fed_changes,
    monthly_df=spy_monthly,
)

spy_cycle_df
```

	Cycle	Start	End	Months	CumulativeReturn	\
0	Cycle 1	2004-11-01	2006-07-01	20	0.11	
1	Cycle 2	2006-07-01	2007-07-01	12	0.20	
2	Cycle 3	2007-07-01	2008-12-01	17	-0.39	
3	Cycle 4	2008-12-01	2015-11-01	83	1.67	
4	Cycle 5	2015-11-01	2019-01-01	38	0.28	
5	Cycle 6	2019-01-01	2019-07-01	6	0.18	
6	Cycle 7	2019-07-01	2020-04-01	9	-0.11	
7	Cycle 8	2020-04-01	2022-02-01	22	0.79	
8	Cycle 9	2022-02-01	2023-08-01	18	0.04	
9	Cycle 10	2023-08-01	2024-08-01	12	0.22	
10	Cycle 11	2024-08-01	2025-12-02	15	0.26	

	CumulativeReturnPct	AverageMonthlyReturn	AverageMonthlyReturnPct	\
0	11.32	0.01	0.59	
1	20.36	0.02	1.57	
2	-38.55	-0.03	-2.67	
3	167.34	0.01	1.28	
4	28.30	0.01	0.70	

5	18.33	0.03	2.95
6	-10.67	-0.01	-1.10
7	79.13	0.03	2.78
8	4.18	0.00	0.40
9	22.00	0.02	1.75
10	25.72	0.02	1.59

	AnnualizedReturn	AnnualizedReturnPct	Volatility	FedFundsChange	\
0	0.07	6.64	0.08	0.03	
1	0.20	20.36	0.07	0.00	
2	-0.29	-29.09	0.19	-0.05	
3	0.15	15.28	0.15	-0.00	
4	0.08	8.19	0.11	0.02	
5	0.40	40.01	0.18	0.00	
6	-0.14	-13.96	0.19	-0.02	
7	0.37	37.43	0.16	0.00	
8	0.03	2.77	0.21	0.05	
9	0.22	22.00	0.15	0.00	
10	0.20	20.09	0.11	-0.01	

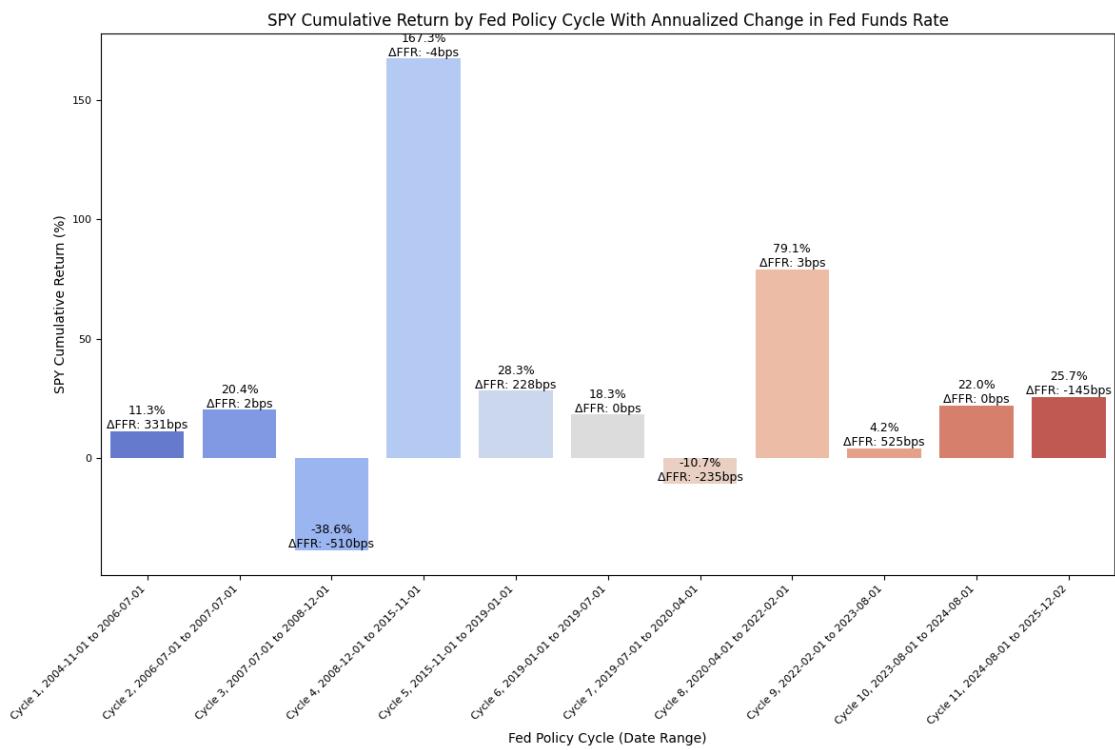
	FedFundsChange_bps	FFR_AnnualizedChange	FFR_AnnualizedChange_bps	\
0	331.00	0.02	198.60	
1	2.00	0.00	2.00	
2	-510.00	-0.04	-360.00	
3	-4.00	-0.00	-0.58	
4	228.00	0.01	72.00	
5	0.00	0.00	0.00	
6	-235.00	-0.03	-313.33	
7	3.00	0.00	1.64	
8	525.00	0.03	350.00	
9	0.00	0.00	0.00	
10	-145.00	-0.01	-116.00	

	Label
0	Cycle 1, 2004-11-01 to 2006-07-01
1	Cycle 2, 2006-07-01 to 2007-07-01
2	Cycle 3, 2007-07-01 to 2008-12-01
3	Cycle 4, 2008-12-01 to 2015-11-01
4	Cycle 5, 2015-11-01 to 2019-01-01
5	Cycle 6, 2019-01-01 to 2019-07-01
6	Cycle 7, 2019-07-01 to 2020-04-01
7	Cycle 8, 2020-04-01 to 2022-02-01
8	Cycle 9, 2022-02-01 to 2023-08-01
9	Cycle 10, 2023-08-01 to 2024-08-01
10	Cycle 11, 2024-08-01 to 2025-12-02

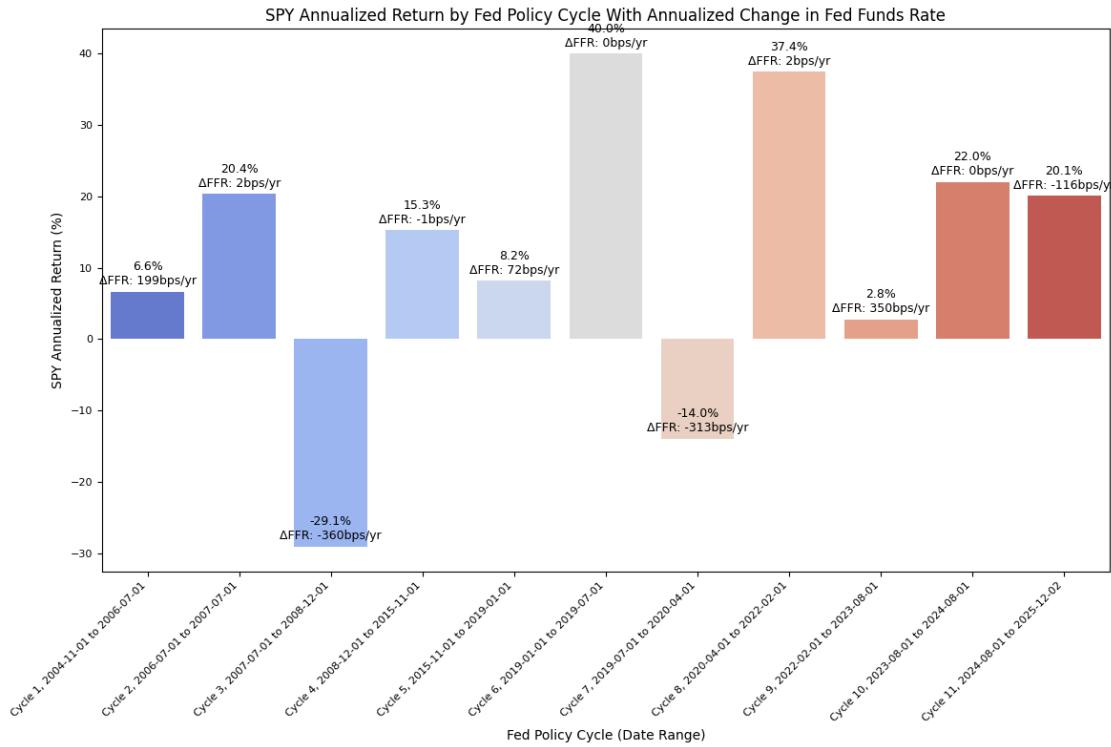
```
[21]: # Copy this <!-- INSERT_02_SPY_Cycle_DF_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file, md_filename="02_SPY_Cycle_DF.md",
                     content=spy_cycle_df.to_markdown(floatfmt=".2f"))
```

Exported and tracked: 02\_SPY\_Cycle\_DF.md

```
[22]: plot_bar_returns_ffr_change(
    cycle_df=spy_cycle_df,
    asset_label="SPY",
    annualized_or_cumulative="Cumulative",
    index_num="02",
)
```



```
[23]: plot_bar_returns_ffr_change(
    cycle_df=spy_cycle_df,
    asset_label="SPY",
    annualized_or_cumulative="Annualized",
    index_num="02",
)
```



```
[24]: df = spy_cycle_df

#####
### Don't modify below this line ###
#####

# Run OLS regression with statsmodels
X = df["FFR_AnnualizedChange_bps"]
y = df["AnnualizedReturnPct"]
X = sm.add_constant(X)
model = sm.OLS(y, X).fit()
print(model.summary())
print(f"Intercept: {model.params[0]}, Slope: {model.params[1]}") # Intercept
# and slope

# Calc X and Y values for regression line
X_vals = np.linspace(X.min(), X.max(), 100)
Y_vals = model.params[0] + model.params[1] * X_vals
```

#### OLS Regression Results

```
=====
Dep. Variable: AnnualizedReturnPct R-squared: 0.180
Model: OLS Adj. R-squared: 0.089
```

```

Method: Least Squares F-statistic: 1.973
Date: Tue, 02 Dec 2025 Prob (F-statistic): 0.194
Time: 20:56:43 Log-Likelihood: -47.173
No. Observations: 11 AIC: 98.35
Df Residuals: 9 BIC: 99.14
Df Model: 1
Covariance Type: nonrobust
=====

=====

            coef    std err      t    P>|t|    [0.025
0.975]
-----
const          12.4404    5.894    2.111    0.064   -0.893
25.774
FFR_AnnualizedChange_bps  0.0430    0.031    1.405    0.194   -0.026
0.112
=====
Omnibus:      1.065 Durbin-Watson: 3.078
Prob(Omnibus): 0.587 Jarque-Bera (JB): 0.665
Skew:          0.026 Prob(JB): 0.717
Kurtosis:     1.796 Cond. No. 193.
=====


```

Notes:

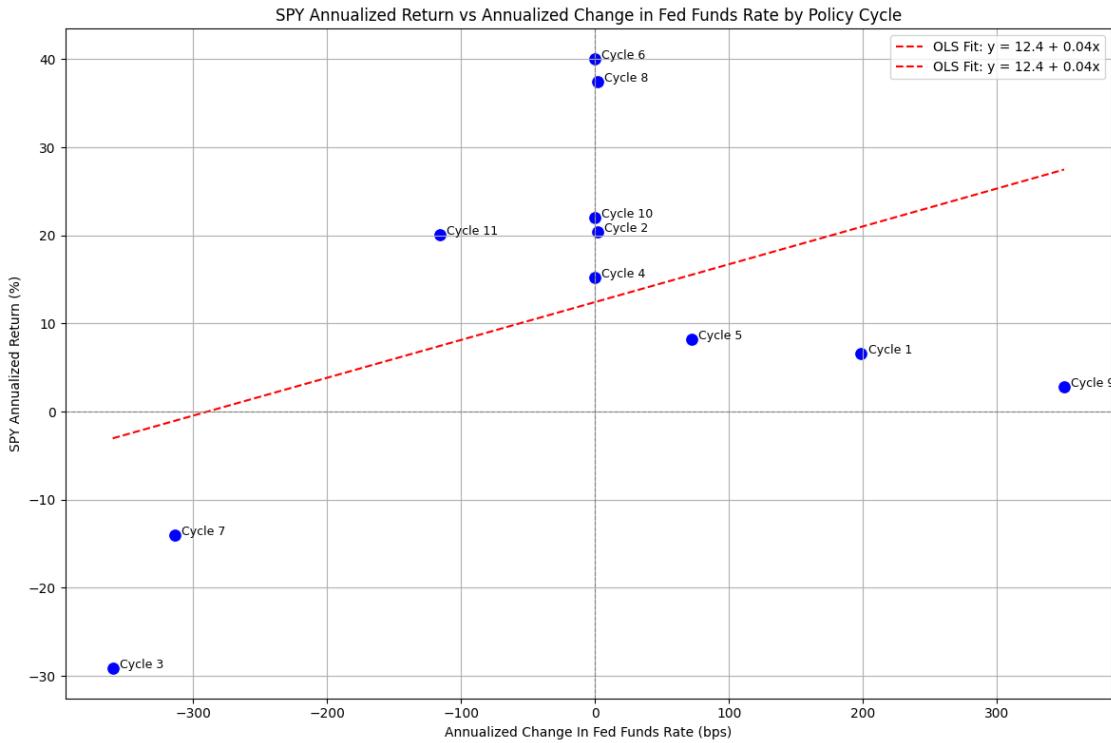
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Intercept: 12.440377492931901, Slope: 0.042973623601991646

```
[25]: # Copy this <!-- INSERT_02_SPY_Annualized_Regression_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file,
                     ↪md_filename="02_SPY_Annualized_Regression.md",
                     ↪content=sm_ols_summary_markdown(result=model,
                     ↪file_path="02_SPY_Annualized_Regression.md"))
```

Exported and tracked: 02\_SPY\_Annualized\_Regression.md

```
[26]: plot_scatter_regression_ffr_vs_returns(
    cycle_df=spy_cycle_df,
    asset_label="SPY",
    index_num="02",
    x_vals=X_vals,
    y_vals=Y_vals,
    intercept=model.params[0],
    slope=model.params[1],
)
```



### 1.6.2 Bonds (TLT)

```
[27]: # Set decimal places
pandas_set_decimal_places(2)
```

```
yf_pull_data(
    base_directory=DATA_DIR,
    ticker="TLT",
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    excel_export=True,
    pickle_export=True,
    output_confirmation=True,
)
```

```
[*****100*****] 1 of 1 completed
```

The first and last date of data for TLT is:

Date	Close	High	Low	Open	Volume
2002-07-30	36.79	36.96	36.79	36.89	6100

```

          Close  High   Low  Open    Volume
Date
2025-12-01  88.77 88.99 88.71 88.85  47086600

Yahoo Finance data complete for TLT
-----

[27]:      Close  High   Low  Open    Volume
Date
2002-07-30  36.79 36.96 36.79 36.89      6100
2002-07-31  37.25 37.37 36.96 36.98     29400
2002-08-01  37.46 37.47 37.25 37.25     25000
2002-08-02  37.84 37.96 37.40 37.53     52800
2002-08-05  38.01 38.11 37.84 37.93     61100
...
2025-11-24  89.69 89.75 89.46 89.63  30865700
2025-11-25  89.92 90.27 89.81 89.99  36503300
2025-11-26  90.32 90.32 89.51 89.83  34099000
2025-11-28  89.89 90.21 89.63 90.14  40704300
2025-12-01  88.77 88.99 88.71 88.85  47086600

[5874 rows x 5 columns]

```

```

[28]: tlt = load_data(
        base_directory=DATA_DIR,
        ticker="TLT",
        source="Yahoo_Finance",
        asset_class="Exchange_Traded_Funds",
        timeframe="Daily",
        file_format="pickle",
    )

# Filter TLT to date range
tlt = tlt[(tlt.index >= pd.to_datetime(start_date)) & (tlt.index <= pd.
    to_datetime(end_date))]

# Resample to monthly frequency
tlt_monthly = tlt.resample("M").last()
tlt_monthly["Monthly_Return"] = tlt_monthly["Close"].pct_change()

```

```
[29]: df_info(tlt_monthly)
```

The columns, shape, and data types are:

```

<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 252 entries, 2004-11-30 to 2025-10-31
Freq: ME
Data columns (total 6 columns):
 #   Column           Non-Null Count  Dtype  
---  -- 
 0   Date             252 non-null    datetime64[ns]
 1   Monthly_Return  252 non-null    float64
 2   Close            252 non-null    float64
 3   High             252 non-null    float64
 4   Low              252 non-null    float64
 5   Open             252 non-null    float64

```

```

0   Close          252 non-null    float64
1   High           252 non-null    float64
2   Low            252 non-null    float64
3   Open           252 non-null    float64
4   Volume          252 non-null    int64
5   Monthly_Return 251 non-null    float64
dtypes: float64(5), int64(1)
memory usage: 13.8 KB
None
The first 5 rows are:

      Close  High  Low  Open  Volume  Monthly_Return
Date
2004-11-30  43.97 44.08 43.81 43.97  1754500          NaN
2004-12-31  45.14 45.19 45.01 45.05  1056400         0.03
2005-01-31  46.75 46.77 46.53 46.55  1313900         0.04
2005-02-28  46.06 46.61 45.99 46.61  2797300        -0.01
2005-03-31  45.85 45.88 45.61 45.78  2410900        -0.00

```

The last 5 rows are:

Date	Close	High	Low	Open	Volume	Monthly_Return
2025-06-30	86.33	86.52	85.71	85.95	53695200	0.03
2025-07-31	85.35	85.83	85.27	85.55	49814100	-0.01
2025-08-31	85.36	85.61	85.20	85.52	41686400	0.00
2025-09-30	88.42	89.09	88.27	88.71	38584000	0.04
2025-10-31	89.64	90.01	89.56	89.91	38247300	0.01

```
[30]: # Copy this <!-- INSERT_03_TLT_Monthly_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file, md_filename="03_TLT_Monthly.md", ↴
content=df_info_markdown(df=tlt_monthly, decimal_places=2))
```

Exported and tracked: 03\_TLT\_Monthly.md

```
[31]: plot_timeseries(
    price_df=tlt,
    plot_start_date=start_date,
    plot_end_date=end_date,
    plot_columns=["Close"],
    title="TLT Close Price",
    x_label="Date",
    x_format="Year",
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing=10,
    grid=True,
    legend=False,
```

```

        export_plot=True,
        plot_file_name="03_TLT_Price",
)

```



```
[32]: tlt_cycle_df = calc_fed_cycle_asset_performance(
    fed_cycles=fed_cycles,
    cycle_labels=cycle_labels,
    fed_changes=fed_changes,
    monthly_df=tlt_monthly,
)
```

```
tlt_cycle_df
```

	Cycle	Start	End	Months	CumulativeReturn	\
0	Cycle 1	2004-11-01	2006-07-01	20	0.04	
1	Cycle 2	2006-07-01	2007-07-01	12	0.06	
2	Cycle 3	2007-07-01	2008-12-01	17	0.32	
3	Cycle 4	2008-12-01	2015-11-01	83	0.46	
4	Cycle 5	2015-11-01	2019-01-01	38	0.07	
5	Cycle 6	2019-01-01	2019-07-01	6	0.10	
6	Cycle 7	2019-07-01	2020-04-01	9	0.26	
7	Cycle 8	2020-04-01	2022-02-01	22	-0.11	
8	Cycle 9	2022-02-01	2023-08-01	18	-0.27	
9	Cycle 10	2023-08-01	2024-08-01	12	-0.02	
10	Cycle 11	2024-08-01	2025-12-02	15	0.00	

	CumulativeReturnPct	AverageMonthlyReturn	AverageMonthlyReturnPct	\
0	4.23	0.00	0.25	

1	5.76	0.00	0.49
2	32.42	0.02	1.73
3	45.67	0.01	0.55
4	7.42	0.00	0.23
5	10.48	0.02	1.73
6	26.18	0.03	2.73
7	-11.33	-0.00	-0.50
8	-26.96	-0.02	-1.62
9	-1.52	0.00	0.02
10	0.42	0.00	0.08

	AnnualizedReturn	AnnualizedReturnPct	Volatility	FedFundsChange	\
0	0.03	2.51	0.09	0.03	
1	0.06	5.76	0.07	0.00	
2	0.22	21.92	0.14	-0.05	
3	0.06	5.59	0.15	-0.00	
4	0.02	2.29	0.10	0.02	
5	0.22	22.05	0.13	0.00	
6	0.36	36.34	0.18	-0.02	
7	-0.06	-6.35	0.11	0.00	
8	-0.19	-18.90	0.17	0.05	
9	-0.02	-1.52	0.20	0.00	
10	0.00	0.33	0.11	-0.01	

	FedFundsChange_bps	FFR_AnnualizedChange	FFR_AnnualizedChange_bps	\
0	331.00	0.02	198.60	
1	2.00	0.00	2.00	
2	-510.00	-0.04	-360.00	
3	-4.00	-0.00	-0.58	
4	228.00	0.01	72.00	
5	0.00	0.00	0.00	
6	-235.00	-0.03	-313.33	
7	3.00	0.00	1.64	
8	525.00	0.03	350.00	
9	0.00	0.00	0.00	
10	-145.00	-0.01	-116.00	

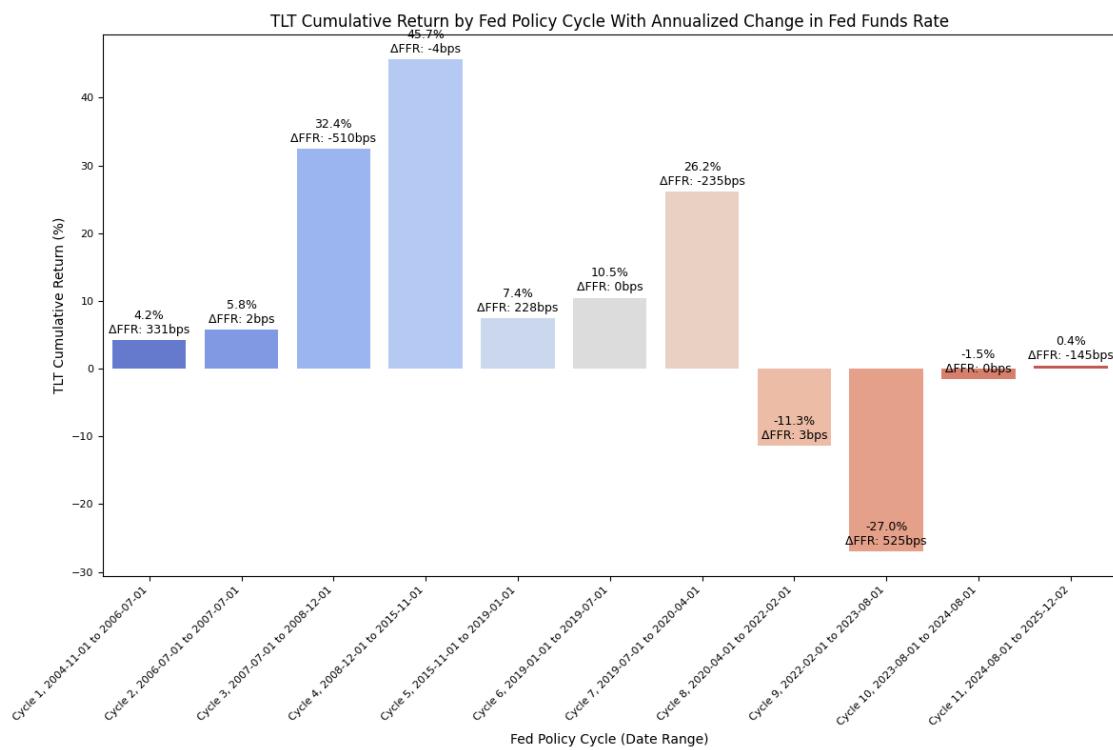
	Label
0	Cycle 1, 2004-11-01 to 2006-07-01
1	Cycle 2, 2006-07-01 to 2007-07-01
2	Cycle 3, 2007-07-01 to 2008-12-01
3	Cycle 4, 2008-12-01 to 2015-11-01
4	Cycle 5, 2015-11-01 to 2019-01-01
5	Cycle 6, 2019-01-01 to 2019-07-01
6	Cycle 7, 2019-07-01 to 2020-04-01
7	Cycle 8, 2020-04-01 to 2022-02-01
8	Cycle 9, 2022-02-01 to 2023-08-01

9 Cycle 10, 2023-08-01 to 2024-08-01  
 10 Cycle 11, 2024-08-01 to 2025-12-02

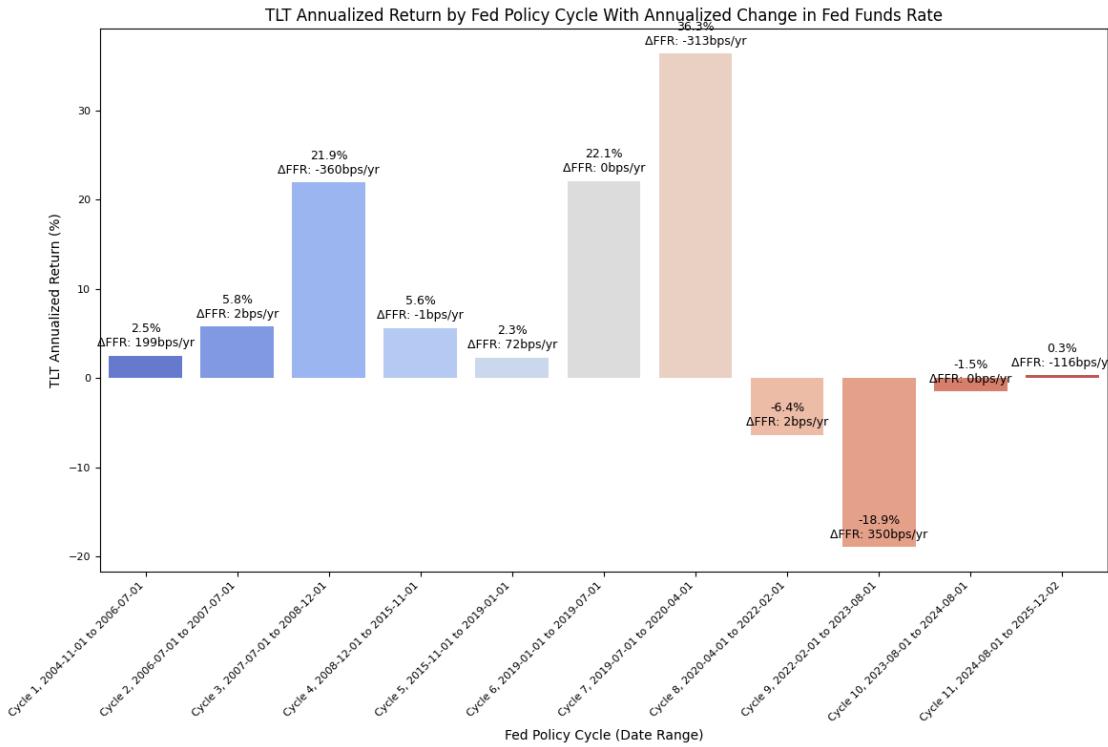
```
[33]: # Copy this <!-- INSERT_03_TLT_Cycle_DF_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file, md_filename="03_TLT_Cycle_DF.md", □
    ↵content=tlt_cycle_df.to_markdown(floatfmt=".2f"))
```

Exported and tracked: 03\_TLT\_Cycle\_DF.md

```
[34]: plot_bar_returns_ffr_change(
    cycle_df=tlt_cycle_df,
    asset_label="TLT",
    annualized_or_cumulative="Cumulative",
    index_num="03",
)
```



```
[35]: plot_bar_returns_ffr_change(
    cycle_df=tlt_cycle_df,
    asset_label="TLT",
    annualized_or_cumulative="Annualized",
    index_num="03",
)
```



```
[36]: df = tlt_cycle_df

#####
### Don't modify below this line ###
#####

# Run OLS regression with statsmodels
X = df["FFR_AnnualizedChange_bps"]
y = df["AnnualizedReturnPct"]
X = sm.add_constant(X)
model = sm.OLS(y, X).fit()
print(model.summary())
print(f"Intercept: {model.params[0]}, Slope: {model.params[1]}") # Intercept
# and slope

# Calc X and Y values for regression line
X_vals = np.linspace(X.min(), X.max(), 100)
Y_vals = model.params[0] + model.params[1] * X_vals
```

#### OLS Regression Results

```
=====
Dep. Variable:      AnnualizedReturnPct    R-squared:                 0.623
Model:                  OLS                 Adj. R-squared:            0.582
```

```

Method: Least Squares F-statistic: 14.90
Date: Tue, 02 Dec 2025 Prob (F-statistic): 0.00385
Time: 20:56:47 Log-Likelihood: -39.665
No. Observations: 11 AIC: 83.33
Df Residuals: 9 BIC: 84.13
Df Model: 1
Covariance Type: nonrobust
=====

=====

            coef    std err      t    P>|t|    [0.025
0.975]
-----
const          5.4676    2.978    1.836    0.100   -1.270
12.205
FFR_AnnualizedChange_bps -0.0597    0.015   -3.860    0.004   -0.095
-0.025
=====
Omnibus: 0.710 Durbin-Watson: 1.220
Prob(Omnibus): 0.701 Jarque-Bera (JB): 0.663
Skew: 0.412 Prob(JB): 0.718
Kurtosis: 2.123 Cond. No. 193.
=====
```

Notes:

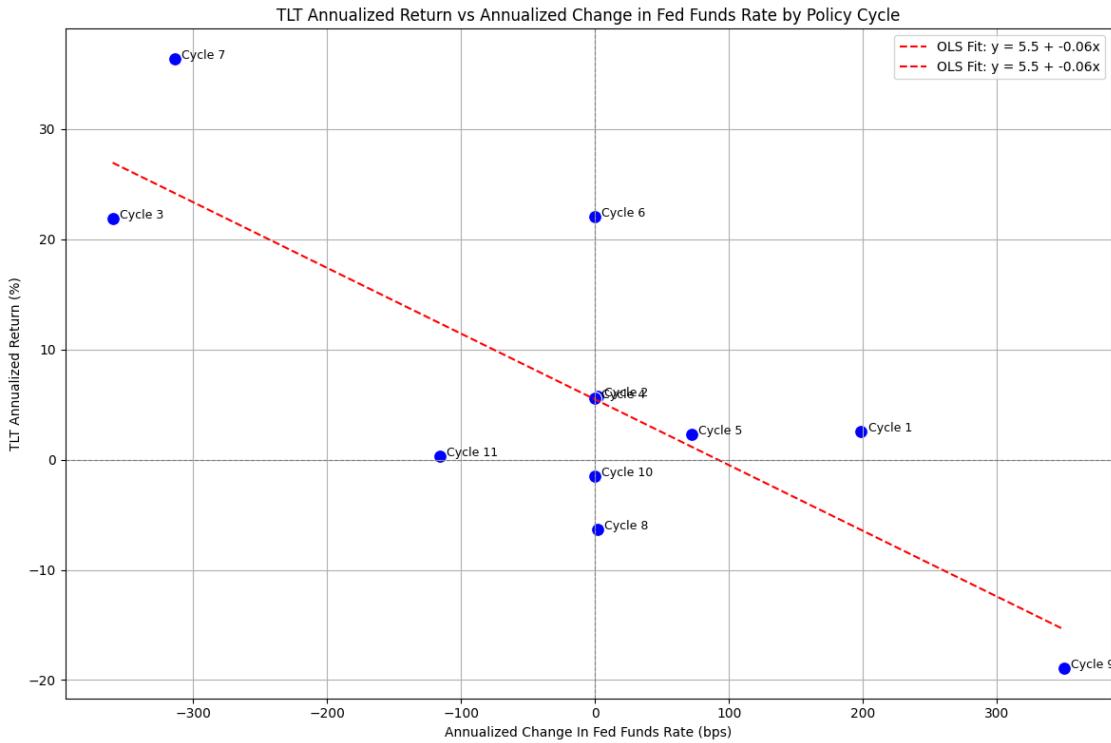
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Intercept: 5.46759506836348, Slope: -0.05966497668600139

```
[37]: # Copy this <!-- INSERT_03_TLT_Annualized_Regression_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file,
                     ↪md_filename="03_TLT_Annualized_Regression.md",
                     ↪content=sm_ols_summary_markdown(result=model,
                     ↪file_path="03_TLT_Annualized_Regression.md"))
```

Exported and tracked: 03\_TLT\_Annualized\_Regression.md

```
[38]: plot_scatter_regression_ffr_vs_returns(
    cycle_df=tlt_cycle_df,
    asset_label="TLT",
    index_num="03",
    x_vals=X_vals,
    y_vals=Y_vals,
    intercept=model.params[0],
    slope=model.params[1],
)
```



### 1.6.3 Gold (GLD)

```
[39]: # Set decimal places
pandas_set_decimal_places(2)
```

```
yf_pull_data(
    base_directory=DATA_DIR,
    ticker="GLD",
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    excel_export=True,
    pickle_export=True,
    output_confirmation=True,
)
```

```
[*****100*****] 1 of 1 completed
```

The first and last date of data for GLD is:

Date	Close	High	Low	Open	Volume
2004-11-18	44.38	44.49	44.07	44.43	5992000

```

      Close   High    Low   Open   Volume
Date
2025-12-01 389.75 390.70 388.06 390.61 11177100

Yahoo Finance data complete for GLD
-----

[39]:      Close   High    Low   Open   Volume
Date
2004-11-18 44.38 44.49 44.07 44.43 5992000
2004-11-19 44.78 44.92 44.47 44.49 11655300
2004-11-22 44.95 44.97 44.74 44.75 11996000
2004-11-23 44.75 44.92 44.72 44.88 3169200
2004-11-24 45.05 45.05 44.79 44.93 6105100
...
...   ...   ...   ...   ...
2025-11-24 380.20 380.28 374.19 374.88 10085300
2025-11-25 380.08 382.52 378.06 380.26 10462800
2025-11-26 383.12 383.78 380.46 381.06 9184100
2025-11-28 387.88 388.00 384.99 385.98 7175400
2025-12-01 389.75 390.70 388.06 390.61 11177100

[5292 rows x 5 columns]

```

```

[40]: gld = load_data(
        base_directory=DATA_DIR,
        ticker="GLD",
        source="Yahoo_Finance",
        asset_class="Exchange_Traded_Funds",
        timeframe="Daily",
        file_format="pickle",
    )

# Filter GLD to date range
gld = gld[(gld.index >= pd.to_datetime(start_date)) & (gld.index <= pd.
    to_datetime(end_date))]

# Resample to monthly frequency
gld_monthly = gld.resample("M").last()
gld_monthly["Monthly_Return"] = gld_monthly["Close"].pct_change()

```

```
[41]: df_info(gld_monthly)
```

The columns, shape, and data types are:

```

<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 252 entries, 2004-11-30 to 2025-10-31
Freq: ME
Data columns (total 6 columns):
 #   Column           Non-Null Count  Dtype  
---  -- 
 0   Date             252 non-null    datetime64[ns]
 1   Monthly_Return  252 non-null    float64
 2   Close            252 non-null    float64
 3   High             252 non-null    float64
 4   Low              252 non-null    float64
 5   Open              252 non-null    float64

```

```

0   Close          252 non-null    float64
1   High           252 non-null    float64
2   Low            252 non-null    float64
3   Open           252 non-null    float64
4   Volume         252 non-null    int64
5   Monthly_Return 251 non-null    float64
dtypes: float64(5), int64(1)
memory usage: 13.8 KB
None
The first 5 rows are:

      Close   High   Low   Open   Volume  Monthly_Return
Date
2004-11-30  45.12 45.41 44.82 45.37  3857200             NaN
2004-12-31  43.80 43.94 43.73 43.85   531600            -0.03
2005-01-31  42.22 42.30 41.96 42.21  1692400            -0.04
2005-02-28  43.53 43.74 43.52 43.68   755300             0.03
2005-03-31  42.82 42.87 42.70 42.87  1363200            -0.02

```

The last 5 rows are:

Date	Close	High	Low	Open	Volume	Monthly_Return
2025-06-30	304.83	304.92	301.95	302.39	8192100	0.00
2025-07-31	302.96	304.61	302.86	304.59	8981000	-0.01
2025-08-31	318.07	318.09	314.64	314.72	15642600	0.05
2025-09-30	355.47	355.57	350.87	351.13	13312400	0.12
2025-10-31	368.12	370.66	365.50	370.47	11077900	0.04

```
[42]: # Copy this <!-- INSERT_04_GLD_Monthly_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file, md_filename="04_GLD_Monthly.md", ↴
                     content=df_info_markdown(df=gld_monthly, decimal_places=2))
```

Exported and tracked: 04\_GLD\_Monthly.md

```
[43]: plot_timeseries(
    price_df=gld,
    plot_start_date=start_date,
    plot_end_date=end_date,
    plot_columns=["Close"],
    title="GLD Close Price",
    x_label="Date",
    x_format="Year",
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing=25,
    grid=True,
    legend=False,
```

```

        export_plot=True,
        plot_file_name="04_GLD_Price",
)

```



```
[44]: gld_cycle_df = calc_fed_cycle_asset_performance(
    fed_cycles=fed_cycles,
    cycle_labels=cycle_labels,
    fed_changes=fed_changes,
    monthly_df=gld_monthly,
)
```

```
gld_cycle_df
```

	Cycle	Start	End	Months	CumulativeReturn	\
0	Cycle 1	2004-11-01	2006-07-01	20	0.36	
1	Cycle 2	2006-07-01	2007-07-01	12	0.05	
2	Cycle 3	2007-07-01	2008-12-01	17	0.25	
3	Cycle 4	2008-12-01	2015-11-01	83	0.36	
4	Cycle 5	2015-11-01	2019-01-01	38	0.11	
5	Cycle 6	2019-01-01	2019-07-01	6	0.10	
6	Cycle 7	2019-07-01	2020-04-01	9	0.11	
7	Cycle 8	2020-04-01	2022-02-01	22	0.14	
8	Cycle 9	2022-02-01	2023-08-01	18	0.08	
9	Cycle 10	2023-08-01	2024-08-01	12	0.24	
10	Cycle 11	2024-08-01	2025-12-02	15	0.62	

	CumulativeReturnPct	AverageMonthlyReturn	AverageMonthlyReturnPct	\
0	35.70	0.02	1.73	

1	4.96	0.00	0.45
2	24.96	0.02	1.59
3	36.10	0.01	0.51
4	10.93	0.00	0.35
5	9.86	0.02	1.63
6	11.15	0.01	1.24
7	13.54	0.01	0.69
8	8.48	0.01	0.53
9	24.24	0.02	1.89
10	62.49	0.03	3.36

	AnnualizedReturn	AnnualizedReturnPct	Volatility	FedFundsChange	\
0	0.20	20.10	0.17	0.03	
1	0.05	4.96	0.11	0.00	
2	0.17	17.03	0.26	-0.05	
3	0.05	4.56	0.18	-0.00	
4	0.03	3.33	0.14	0.02	
5	0.21	20.68	0.12	0.00	
6	0.15	15.13	0.13	-0.02	
7	0.07	7.17	0.16	0.00	
8	0.06	5.58	0.14	0.05	
9	0.24	24.24	0.13	0.00	
10	0.47	47.46	0.14	-0.01	

	FedFundsChange_bps	FFR_AnnualizedChange	FFR_AnnualizedChange_bps	\
0	331.00	0.02	198.60	
1	2.00	0.00	2.00	
2	-510.00	-0.04	-360.00	
3	-4.00	-0.00	-0.58	
4	228.00	0.01	72.00	
5	0.00	0.00	0.00	
6	-235.00	-0.03	-313.33	
7	3.00	0.00	1.64	
8	525.00	0.03	350.00	
9	0.00	0.00	0.00	
10	-145.00	-0.01	-116.00	

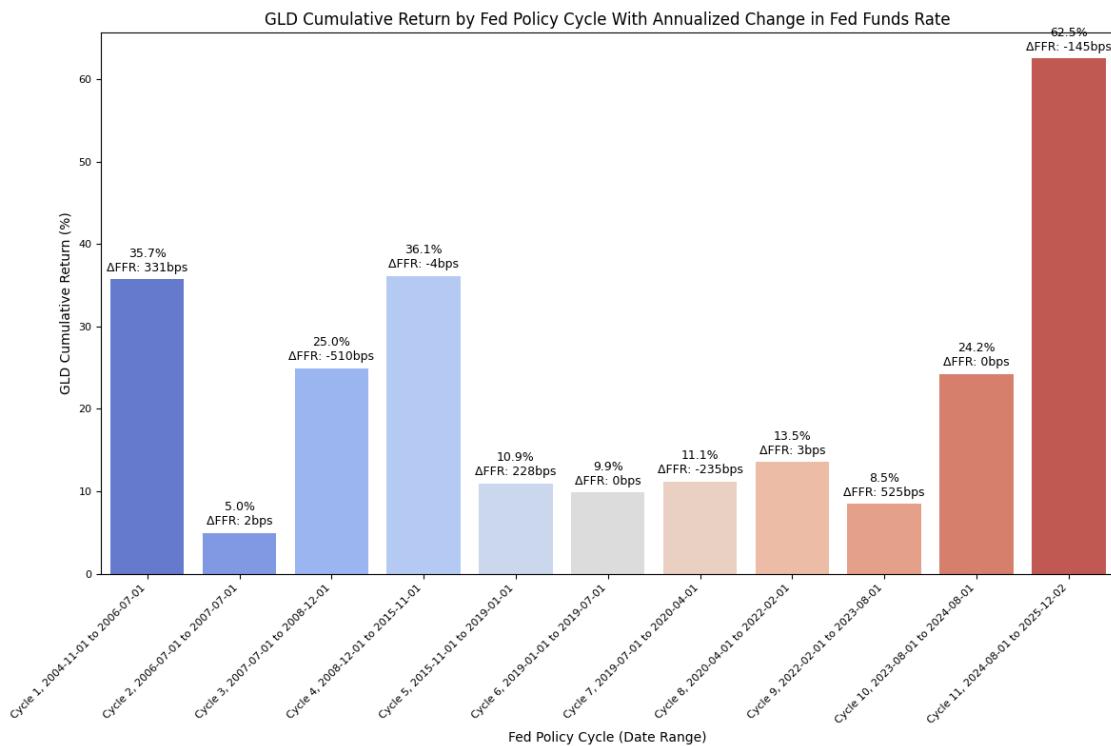
	Label
0	Cycle 1, 2004-11-01 to 2006-07-01
1	Cycle 2, 2006-07-01 to 2007-07-01
2	Cycle 3, 2007-07-01 to 2008-12-01
3	Cycle 4, 2008-12-01 to 2015-11-01
4	Cycle 5, 2015-11-01 to 2019-01-01
5	Cycle 6, 2019-01-01 to 2019-07-01
6	Cycle 7, 2019-07-01 to 2020-04-01
7	Cycle 8, 2020-04-01 to 2022-02-01
8	Cycle 9, 2022-02-01 to 2023-08-01

9 Cycle 10, 2023-08-01 to 2024-08-01  
 10 Cycle 11, 2024-08-01 to 2025-12-02

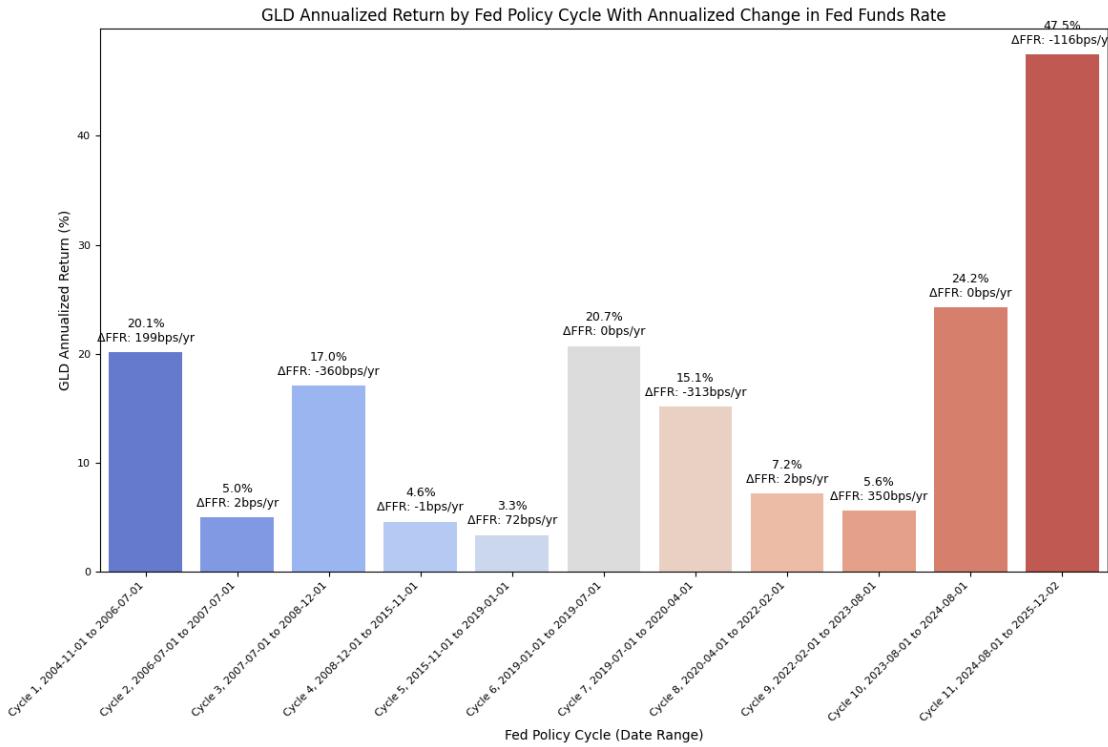
```
[45]: # Copy this <!-- INSERT_04_GLD_Cycle_DF_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file, md_filename="04_GLD_Cycle_DF.md", ▾
    ↴content=gld_cycle_df.to_markdown(floatfmt=".2f"))
```

Exported and tracked: 04\_GLD\_Cycle\_DF.md

```
[46]: plot_bar_returns_ffr_change(
    cycle_df=gld_cycle_df,
    asset_label="GLD",
    annualized_or_cumulative="Cumulative",
    index_num="04",
)
```



```
[47]: plot_bar_returns_ffr_change(
    cycle_df=gld_cycle_df,
    asset_label="GLD",
    annualized_or_cumulative="Annualized",
    index_num="04",
)
```



```
[48]: df = gld_cycle_df
```

```
#####
### Don't modify below this line #####
#####

# Run OLS regression with statsmodels
X = df["FFR_AnnualizedChange_bps"]
y = df["AnnualizedReturnPct"]
X = sm.add_constant(X)
model = sm.OLS(y, X).fit()
print(model.summary())
print(f"Intercept: {model.params[0]}, Slope: {model.params[1]}") # Intercept
# and slope

# Calc X and Y values for regression line
X_vals = np.linspace(X.min(), X.max(), 100)
Y_vals = model.params[0] + model.params[1] * X_vals
```

#### OLS Regression Results

```
=====
Dep. Variable: AnnualizedReturnPct R-squared: 0.084
Model: OLS Adj. R-squared: -0.018
```

```

Method: Least Squares F-statistic: 0.8274
Date: Tue, 02 Dec 2025 Prob (F-statistic): 0.387
Time: 20:56:51 Log-Likelihood: -42.830
No. Observations: 11 AIC: 89.66
Df Residuals: 9 BIC: 90.46
Df Model: 1
Covariance Type: nonrobust
=====

=====

            coef    std err      t    P>|t|    [0.025
0.975]
-----
const          15.1947    3.972     3.826    0.004    6.210
24.179
FFR_AnnualizedChange_bps -0.0187    0.021    -0.910    0.387   -0.065
0.028
=====
Omnibus: 8.035 Durbin-Watson: 0.915
Prob(Omnibus): 0.018 Jarque-Bera (JB): 3.686
Skew: 1.328 Prob(JB): 0.158
Kurtosis: 3.993 Cond. No. 193.
=====
```

Notes:

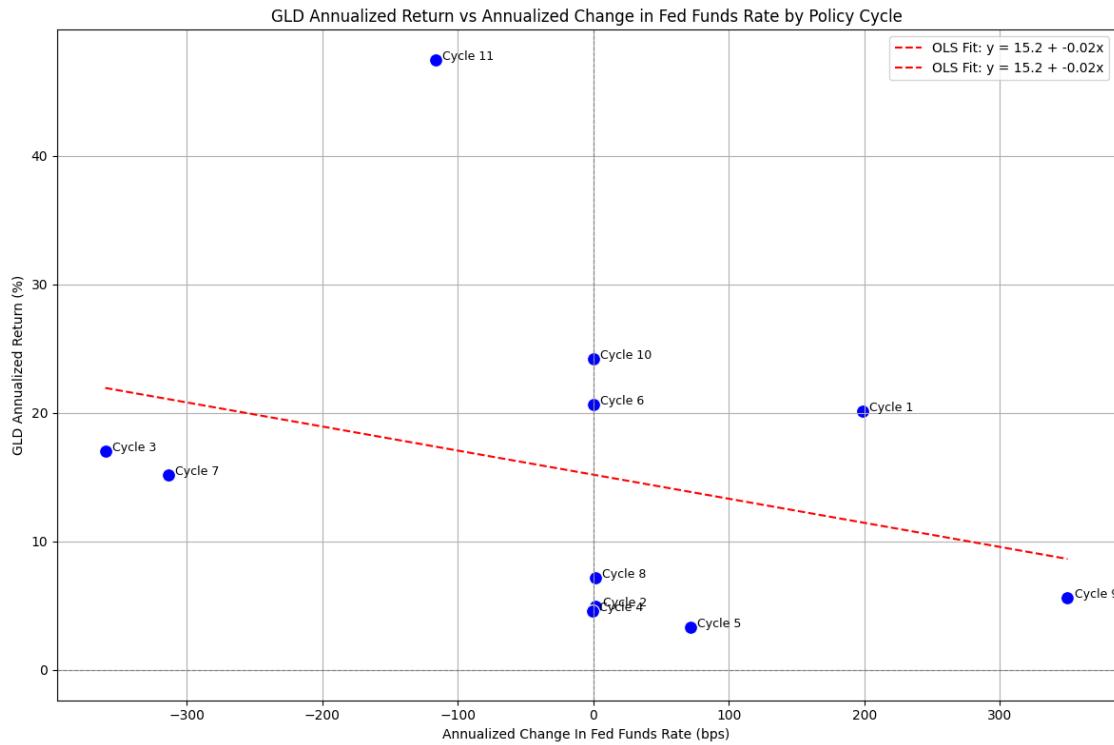
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Intercept: 15.19466510751222, Slope: -0.018749970694326247

```
[49]: # Copy this <!-- INSERT_04_GLD_Annualized_Regression_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file,
                     ↪md_filename="04_GLD_Annualized_Regression.md",
                     ↪content=sm_ols_summary_markdown(result=model,
                     ↪file_path="04_GLD_Annualized_Regression.md"))
```

Exported and tracked: 04\_GLD\_Annualized\_Regression.md

```
[50]: plot_scatter_regression_ffr_vs_returns(
    cycle_df=gld_cycle_df,
    asset_label="GLD",
    index_num="04",
    x_vals=X_vals,
    y_vals=Y_vals,
    intercept=model.params[0],
    slope=model.params[1],
)
```



## 1.7 Hybrid Portfolio

### 1.7.1 Asset Allocation

```
[51]: fed_cycles
```

```
[51]: [('2004-11-01', '2006-07-01'),
 ('2006-07-01', '2007-07-01'),
 ('2007-07-01', '2008-12-01'),
 ('2008-12-01', '2015-11-01'),
 ('2015-11-01', '2019-01-01'),
 ('2019-01-01', '2019-07-01'),
 ('2019-07-01', '2020-04-01'),
 ('2020-04-01', '2022-02-01'),
 ('2022-02-01', '2023-08-01'),
 ('2023-08-01', '2024-08-01'),
 ('2024-08-01', '2025-12-02')]
```

```
[52]: cycle_labels
```

```
[52]: ['Cycle 1',
 'Cycle 2',
 'Cycle 3',
 'Cycle 4',
```

```

'Cycle 5',
'Cycle 6',
'Cycle 7',
'Cycle 8',
'Cycle 9',
'Cycle 10',
'Cycle 11']

[53]: # Calculate cumulative returns and drawdown for SPY
spy_monthly['Cumulative_Return'] = (1 + spy_monthly['Monthly_Return']).  

    ↪cumprod() - 1
spy_monthly['Cumulative_Return_Plus_One'] = 1 + spy_monthly['Cumulative_Return']
spy_monthly['Rolling_Max'] = spy_monthly['Cumulative_Return_Plus_One'].cummax()
spy_monthly['Drawdown'] = spy_monthly['Cumulative_Return_Plus_One'] /  

    ↪spy_monthly['Rolling_Max'] - 1
spy_monthly.drop(columns=['Cumulative_Return_Plus_One', 'Rolling_Max'],  

    ↪inplace=True)

# Calculate cumulative returns and drawdown for TLT
tlt_monthly['Cumulative_Return'] = (1 + tlt_monthly['Monthly_Return']).  

    ↪cumprod() - 1
tlt_monthly['Cumulative_Return_Plus_One'] = 1 + tlt_monthly['Cumulative_Return']
tlt_monthly['Rolling_Max'] = tlt_monthly['Cumulative_Return_Plus_One'].cummax()
tlt_monthly['Drawdown'] = tlt_monthly['Cumulative_Return_Plus_One'] /  

    ↪tlt_monthly['Rolling_Max'] - 1
tlt_monthly.drop(columns=['Cumulative_Return_Plus_One', 'Rolling_Max'],  

    ↪inplace=True)

# Isolate the returns for SPY and TLT
spy_ret = spy_monthly['Monthly_Return']
tlt_ret = tlt_monthly['Monthly_Return']

# Create a blended portfolio based on Fed policy cycles
portfolio = (
    spy_ret[spy_ret.index <= "2007-07-01"]
    .combine_first(tlt_ret[(tlt_ret.index >= "2007-07-01") & (tlt_ret.index <=  

        ↪"2008-12-01")])
    .combine_first(spy_ret[(spy_ret.index > "2008-12-01") & (spy_ret.index <=  

        ↪"2019-07-01")])
    .combine_first(tlt_ret[(tlt_ret.index >= "2019-07-01") & (tlt_ret.index <=  

        ↪"2020-04-01")])
    .combine_first(spy_ret[(spy_ret.index > "2020-04-01") & (spy_ret.index <=  

        ↪"2024-08-01")])
    .combine_first(tlt_ret[tlt_ret.index > "2024-08-01"])
)

```

```

# Convert to DataFrame
portfolio_monthly = portfolio.to_frame(name="Portfolio_Monthly_Return")

# Calculate cumulative returns and drawdown for the portfolio
portfolio_monthly['Portfolio_Cumulative_Return'] = (1 +_
    ↪portfolio_monthly['Portfolio_Monthly_Return']).cumprod() - 1
portfolio_monthly['Portfolio_Cumulative_Return_Plus_One'] = 1 +_
    ↪portfolio_monthly['Portfolio_Cumulative_Return']
portfolio_monthly['Portfolio_Rolling_Max'] =_
    ↪portfolio_monthly['Portfolio_Cumulative_Return_Plus_One'].cummax()
portfolio_monthly['Portfolio_Drawdown'] =_
    ↪portfolio_monthly['Portfolio_Cumulative_Return_Plus_One'] /_
    ↪portfolio_monthly['Portfolio_Rolling_Max'] - 1
portfolio_monthly.drop(columns=['Portfolio_Cumulative_Return_Plus_One',_
    ↪'Portfolio_Rolling_Max'], inplace=True)

# Merge "spy_monthly" and "tlt_monthly" into "portfolio_monthly" to compare_
    ↪cumulative returns
portfolio_monthly = portfolio_monthly.join(
    spy_monthly['Monthly_Return'].rename('SPY_Monthly_Return'),
    how='left'
).join(
    spy_monthly['Cumulative_Return'].rename('SPY_Cumulative_Return'),
    how='left'
).join(
    spy_monthly['Drawdown'].rename('SPY_Drawdown'),
    how='left'
).join(
    tlt_monthly['Monthly_Return'].rename('TLT_Monthly_Return'),
    how='left'
).join(
    tlt_monthly['Cumulative_Return'].rename('TLT_Cumulative_Return'),
    how='left'
).join(
    tlt_monthly['Drawdown'].rename('TLT_Drawdown'),
    how='left'
)

```

[54]: df\_info(portfolio\_monthly)

The columns, shape, and data types are:  
<class 'pandas.core.frame.DataFrame'>  
DatetimeIndex: 252 entries, 2004-11-30 to 2025-10-31  
Freq: ME  
Data columns (total 9 columns):  
# Column Non-Null Count Dtype  
--- -----

```
0    Portfolio_Monthly_Return    251 non-null    float64
1    Portfolio_Cumulative_Return 251 non-null    float64
2    Portfolio_Drawdown         251 non-null    float64
3    SPY_Monthly_Return        251 non-null    float64
4    SPY_Cumulative_Return     251 non-null    float64
5    SPY_Drawdown             251 non-null    float64
6    TLT_Monthly_Return       251 non-null    float64
7    TLT_Cumulative_Return    251 non-null    float64
8    TLT_Drawdown             251 non-null    float64
```

dtypes: float64(9)

memory usage: 19.7 KB

None

The first 5 rows are:

```
          Portfolio_Monthly_Return  Portfolio_Cumulative_Return \
Date
2004-11-30              NaN                  NaN
2004-12-31              0.03                 0.03
2005-01-31             -0.02                 0.01
2005-02-28              0.02                 0.03
2005-03-31             -0.02                 0.01
```

```
          Portfolio_Drawdown  SPY_Monthly_Return  SPY_Cumulative_Return \
Date
2004-11-30              NaN                  NaN                  NaN
2004-12-31              0.00                 0.03                 0.03
2005-01-31             -0.02                -0.02                 0.01
2005-02-28             -0.00                 0.02                 0.03
2005-03-31             -0.02                -0.02                 0.01
```

```
          SPY_Drawdown  TLT_Monthly_Return  TLT_Cumulative_Return \
Date
2004-11-30              NaN                  NaN                  NaN
2004-12-31              0.00                 0.03                 0.03
2005-01-31             -0.02                 0.04                 0.06
2005-02-28             -0.00                -0.01                 0.05
2005-03-31             -0.02                -0.00                 0.04
```

```
          TLT_Drawdown
Date
2004-11-30              NaN
2004-12-31              0.00
2005-01-31              0.00
2005-02-28             -0.01
2005-03-31             -0.02
```

The last 5 rows are:

```
          Portfolio_Monthly_Return  Portfolio_Cumulative_Return \
```

Date	Portfolio_Drawdown	SPY_Monthly_Return	SPY_Cumulative_Return
2025-06-30	0.03	19.00	
2025-07-31	-0.01	18.78	
2025-08-31	0.00	18.78	
2025-09-30	0.04	19.49	
2025-10-31	0.01	19.77	

Date	SPY_Drawdown	TLT_Monthly_Return	TLT_Cumulative_Return
2025-06-30	-0.07	0.05	6.72
2025-07-31	-0.08	0.02	6.90
2025-08-31	-0.08	0.02	7.06
2025-09-30	-0.05	0.04	7.34
2025-10-31	-0.04	0.02	7.54

Date	TLT_Drawdown
2025-06-30	-0.41
2025-07-31	-0.41
2025-08-31	-0.41
2025-09-30	-0.39
2025-10-31	-0.39

```
[55]: # Copy this <!-- INSERT_05_Portfolio_DF_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file, md_filename="05_Portfolio_DF.md",
                     content=df_info_markdown(df=portfolio_monthly, decimal_places=3))
```

Exported and tracked: 05\_Portfolio\_DF.md

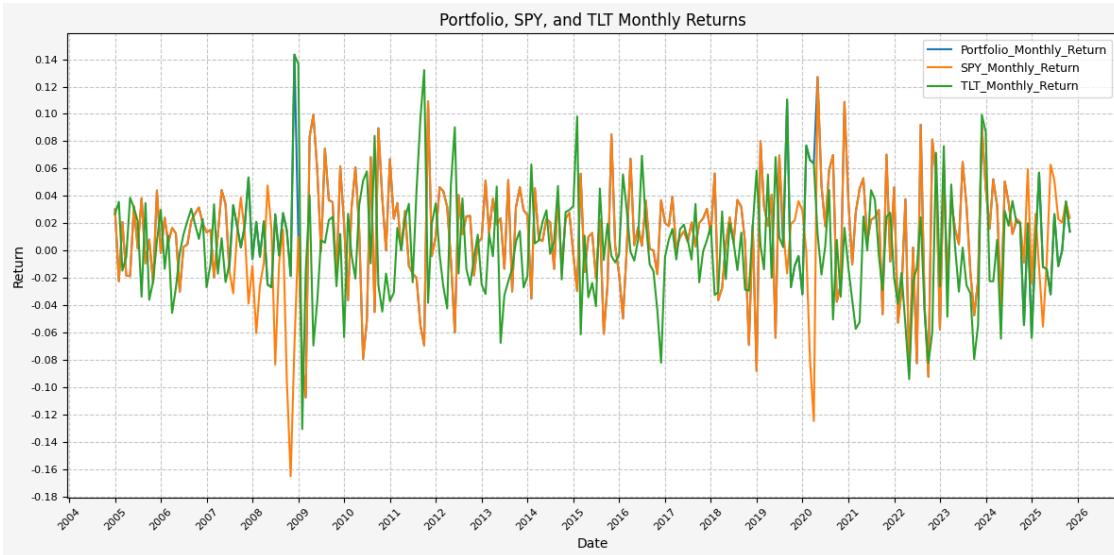
### 1.7.2 Performance Statistics

```
[56]: plot_timeseries(
    price_df=portfolio_monthly,
    plot_start_date=start_date,
    plot_end_date=end_date,
    plot_columns=["Portfolio_Monthly_Return", "SPY_Monthly_Return",
                  "TLT_Monthly_Return"],
    title="Portfolio, SPY, and TLT Monthly Returns",
    x_label="Date",
    x_format="Year",
```

```

        y_label="Return",
        y_format="Decimal",
        y_format_decimal_places=2,
        y_tick_spacing=0.02,
        grid=True,
        legend=True,
        export_plot=True,
        plot_file_name="05_Monthly_Returns",
)

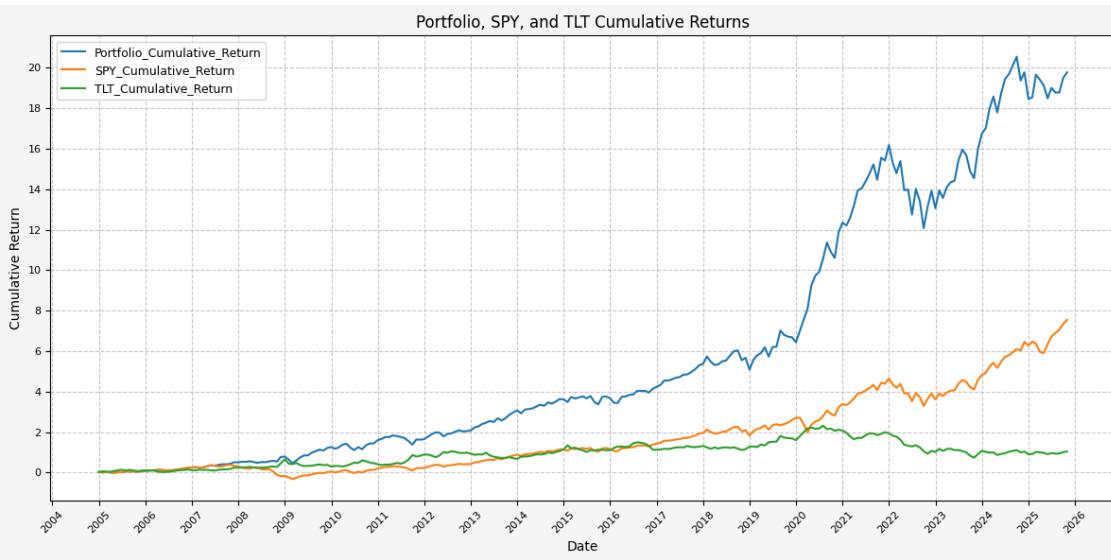
```



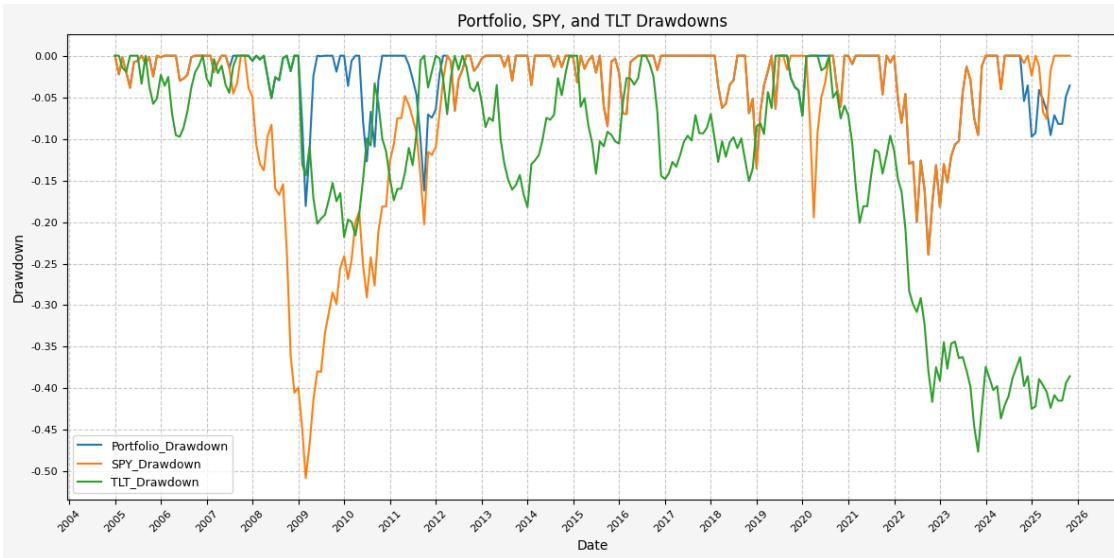
```

[57]: plot_timeseries(
    price_df=portfolio_monthly,
    plot_start_date=start_date,
    plot_end_date=end_date,
    plot_columns=["Portfolio_Cumulative_Return", "SPY_Cumulative_Return", ↴
    "TLT_Cumulative_Return"],
    title="Portfolio, SPY, and TLT Cumulative Returns",
    x_label="Date",
    x_format="Year",
    y_label="Cumulative Return",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing=2,
    grid=True,
    legend=True,
    export_plot=True,
    plot_file_name="05_Cumulative>Returns",
)

```



```
[58]: plot_timeseries(
    price_df=portfolio_monthly,
    plot_start_date=start_date,
    plot_end_date=end_date,
    plot_columns=["Portfolio_Drawdown", "SPY_Drawdown", "TLT_Drawdown"],
    title="Portfolio, SPY, and TLT Drawdowns",
    x_label="Date",
    x_format="Year",
    y_label="Drawdown",
    y_format="Decimal",
    y_format_decimal_places=2,
    y_tick_spacing=0.05,
    grid=True,
    legend=True,
    export_plot=True,
    plot_file_name="05_Drawdowns",
)
```



```
[59]: port_sum_stats = summary_stats(
    fund_list=["Portfolio", "SPY", "TLT"],
    df=portfolio_monthly[["Portfolio_Monthly_Return"]], 
    period="Monthly",
    use_calendar_days=False,
    excel_export=False,
    pickle_export=False,
    output_confirmation=False,
)

spy_sum_stats = summary_stats(
    fund_list=["Portfolio", "SPY", "TLT"],
    df=portfolio_monthly[["SPY_Monthly_Return"]], 
    period="Monthly",
    use_calendar_days=False,
    excel_export=False,
    pickle_export=False,
    output_confirmation=False,
)

tlt_sum_stats = summary_stats(
    fund_list=["Portfolio", "SPY", "TLT"],
    df=portfolio_monthly[["TLT_Monthly_Return"]], 
    period="Monthly",
    use_calendar_days=False,
    excel_export=False,
    pickle_export=False,
    output_confirmation=False,
```

```
)  
  
sum_stats = port_sum_stats.combine_first(spy_sum_stats).  
    ↳combine_first(tlt_sum_stats)
```

```
[60]: # Copy this <!-- INSERT_05_Portfolio_Stats_DF_HERE --> to index_temp.md  
export_track_md_deps(dep_file=dep_file, md_filename="05_Portfolio_Stats_DF.md",  
    ↳content=sum_stats.to_markdown(floatfmt=".3f"))
```

Exported and tracked: 05\_Portfolio\_Stats\_DF.md