asset-class-performance-fed-policy-cycles

November 29, 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
```

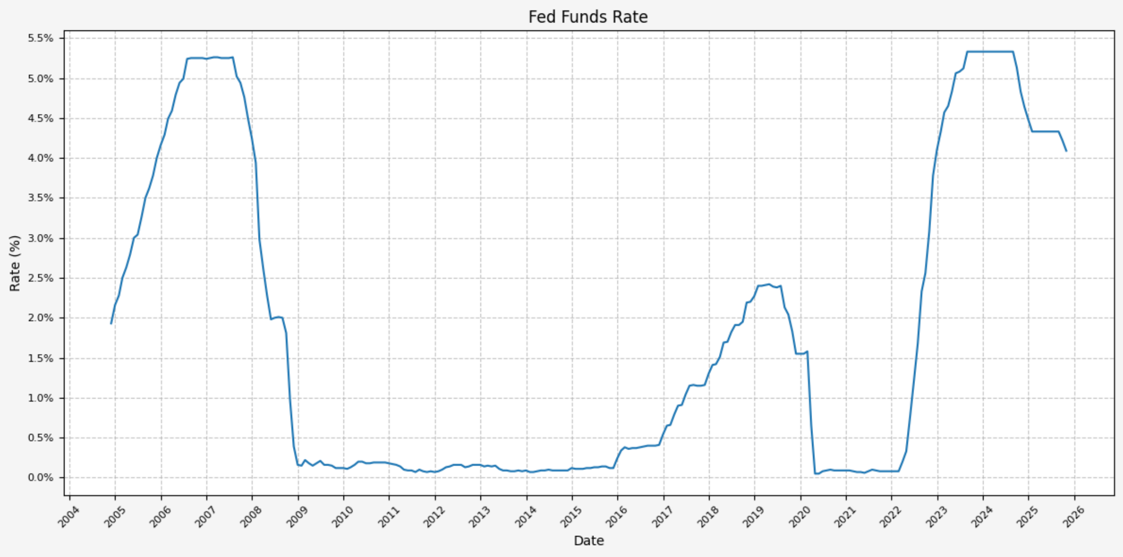
[8]:

```
# 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
```

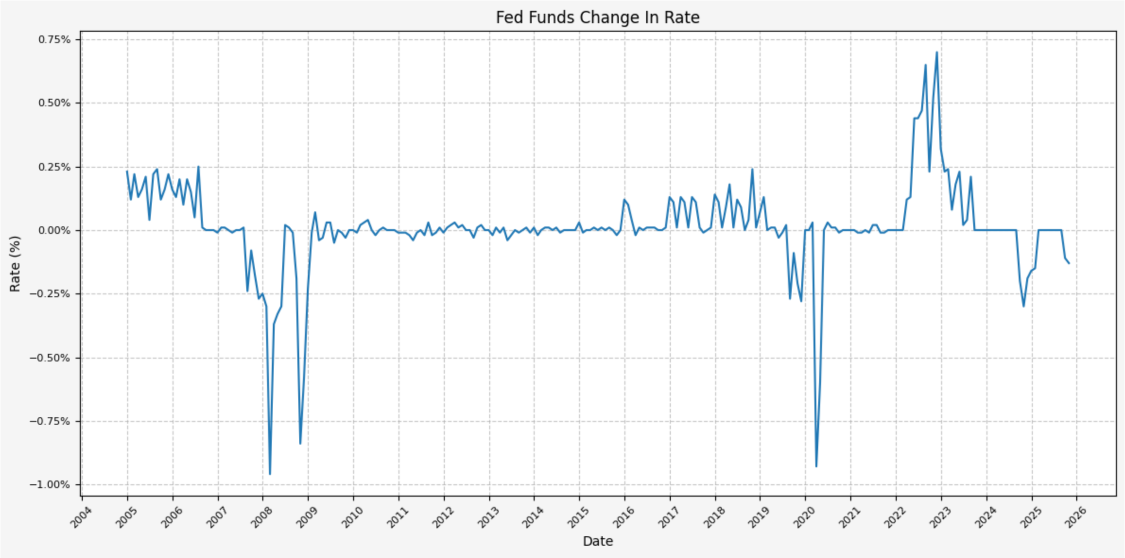
[9]:

```
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          -0.0124
```

[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,
)
```

```
YF.download() has changed argument auto_adjust default to 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
2025-11-26 679.68 681.70 676.72 677.63  71879600

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
…              …      …      …      …          …
2025-11-20  652.53  675.56  651.89  672.91  165293500
2025-11-21  659.03  664.55  650.85  655.05  123956200
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

[8265 rows x 5 columns]
```

[16]:

```python
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]:

```python
df_info(spy_monthly)
```

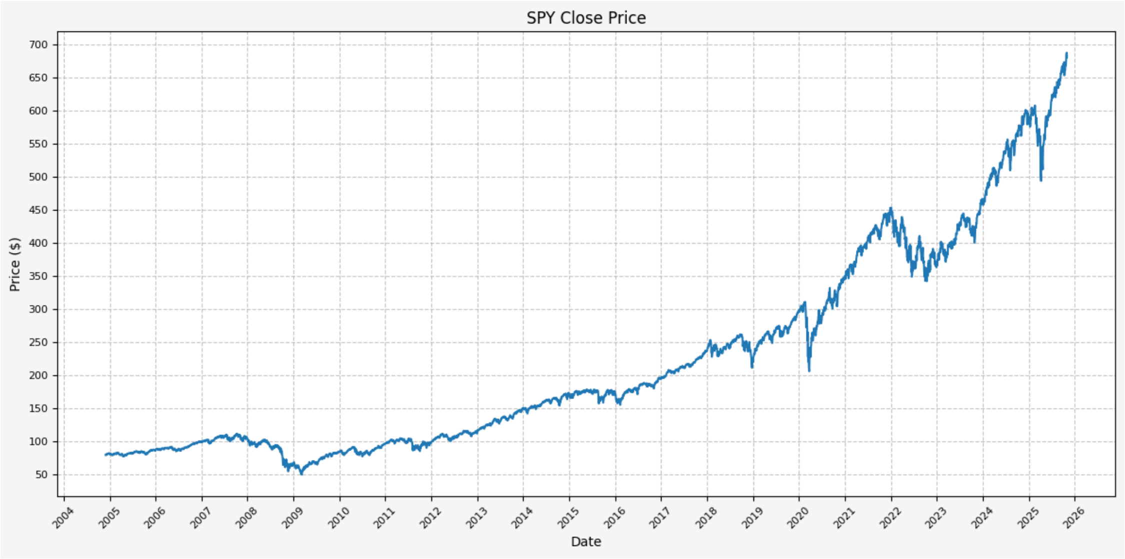
```
The columns, shape, and data types are:
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 252 entries, 2004-11-30 to 2025-10-31
Freq: ME
Data columns (total 6 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Close           252 non-null    float64
 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:

             Close  High   Low  Open    Volume  Monthly_Return
Date
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:

             Close   High    Low   Open     Volume  Monthly_Return
Date
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]:
```python
# 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]:
```python
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
```

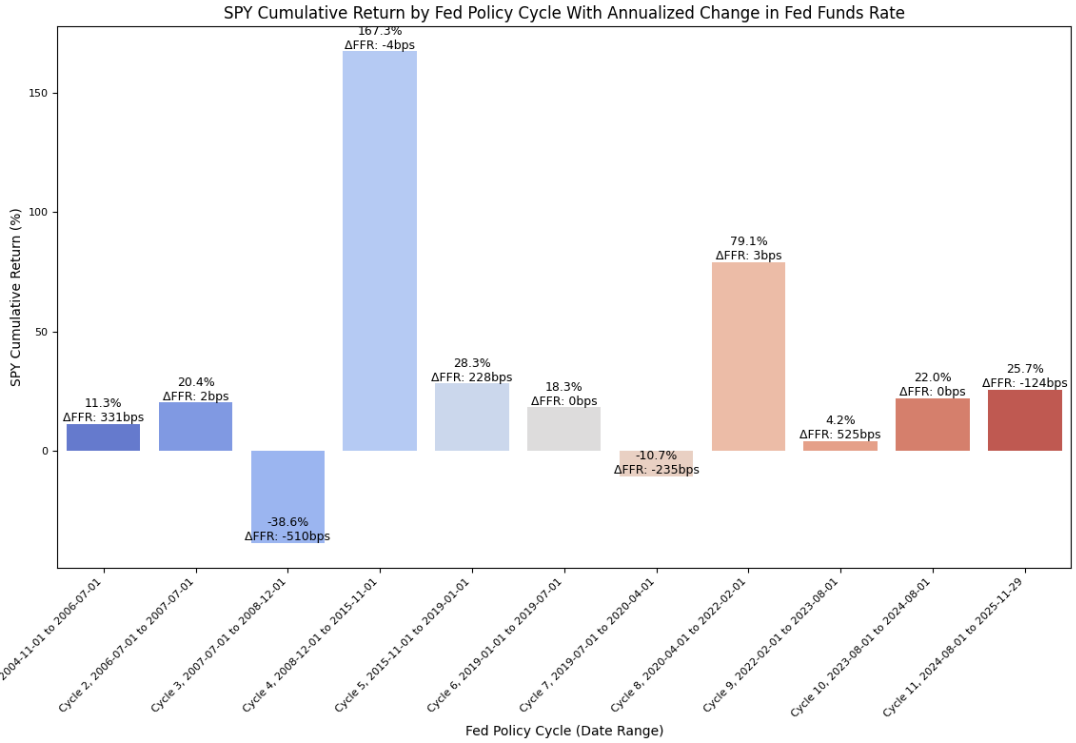
```
[20]:       Cycle       Start         End  Months  CumulativeReturn  \
      0    Cycle 1  2004-11-01  2006-07-01      20              0.11
      1    Cycle 2  2006-07-01  2007-07-01      12              0.20
      2    Cycle 3  2007-07-01  2008-12-01      17             -0.39
      3    Cycle 4  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  2025-11-29      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             -124.00                 -0.01                    -99.20

                                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 2025-11-29
```

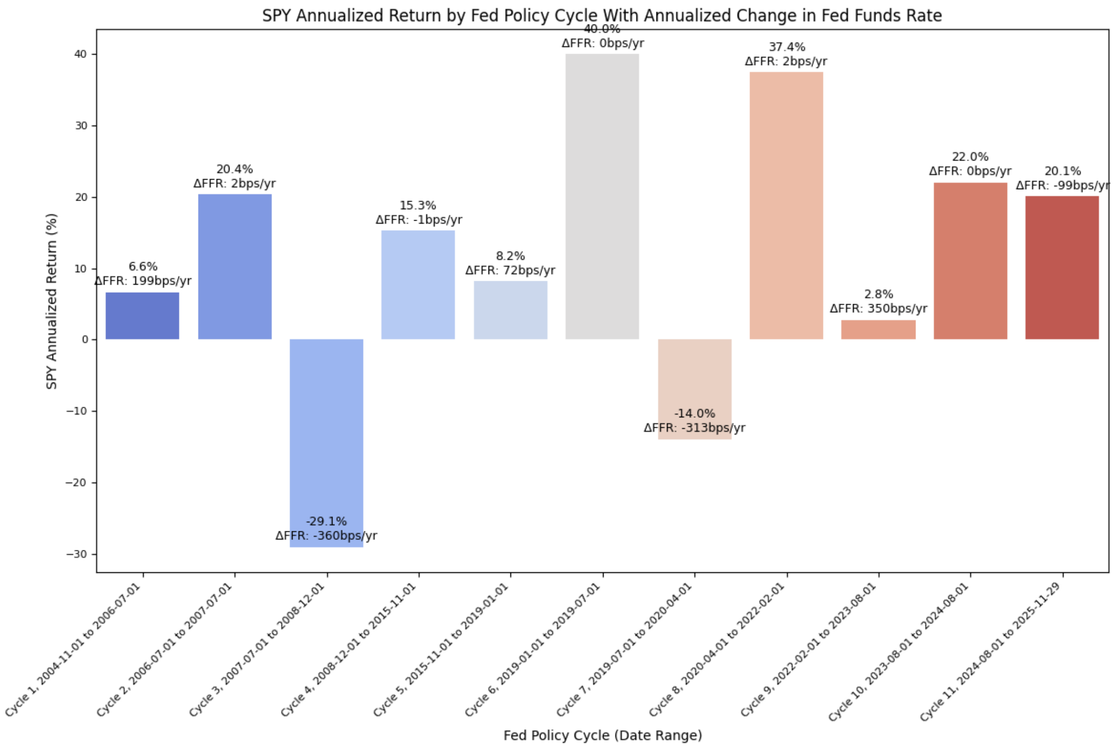
```
[21]: # Copy this <!-- INSERT_02_SPY_Cycle_DF_HERE --> to index_temp.md
      export_track_md_deps(dep_file=dep_file, md_filename="02_SPY_Cycle_DF.md",␣
       ↪content=spy_cycle_df.to_markdown(floatfmt=".2f"))
```

```
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:                       0.184
Model:                             OLS   Adj. R-squared:                  0.093
```

```
Method:                 Least Squares   F-statistic:                     2.031
Date:                Sat, 29 Nov 2025   Prob (F-statistic):              0.188
Time:                        17:09:56   Log-Likelihood:                -47.144
No. Observations:                  11   AIC:                             98.29
Df Residuals:                       9   BIC:                             99.08
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
============
                              coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
------------
const                      12.3840      5.875      2.108      0.064      -0.907
25.675
FFR_AnnualizedChange_bps    0.0437      0.031      1.425      0.188      -0.026
0.113
==============================================================================
Omnibus:                        1.011   Durbin-Watson:                   3.089
Prob(Omnibus):                  0.603   Jarque-Bera (JB):                0.652
Skew:                           0.032   Prob(JB):                        0.722
Kurtosis:                       1.809   Cond. No.                         192.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
Intercept: 12.383972056848604, Slope: 0.043654430864842844
```

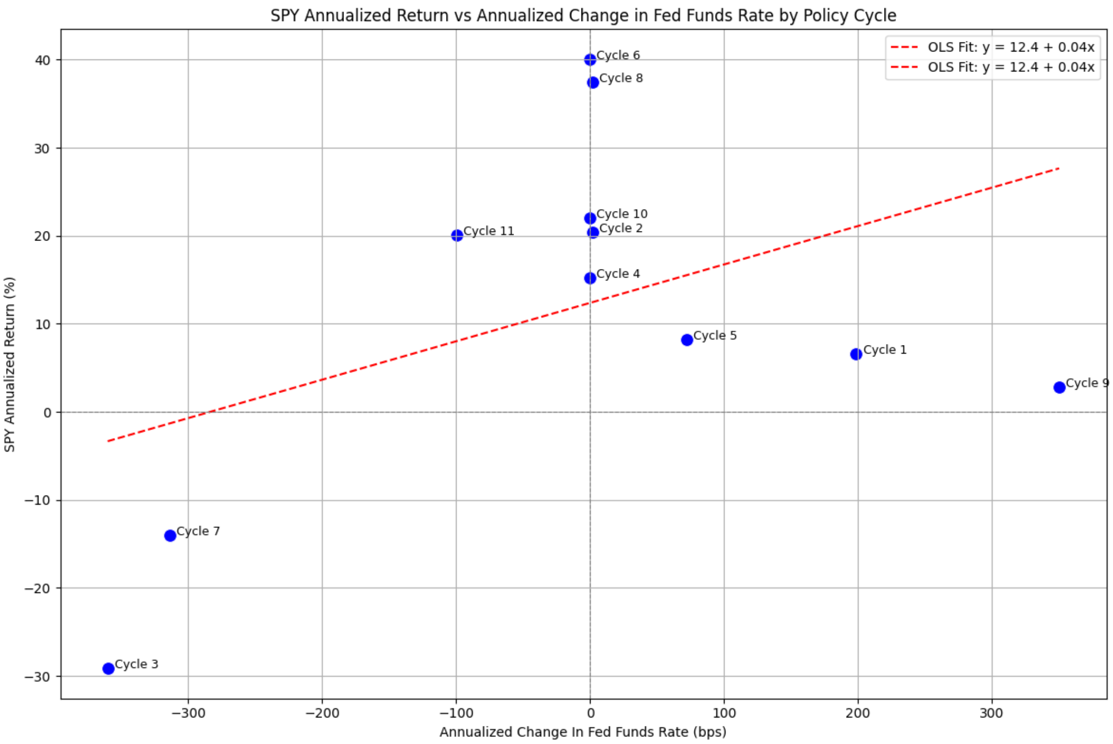
[25]:

```python
# 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]:

```python
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:

            Close  High   Low  Open  Volume
Date
2002-07-30  36.92 37.09 36.92 37.03    6100
```

```
            Close  High   Low  Open    Volume
Date
2025-11-26  90.64 90.64 89.83 90.15  34099000

Yahoo Finance data complete for TLT
--------------------
```

[27]:

```
            Close  High   Low  Open    Volume
Date
2002-07-30  36.92 37.09 36.92 37.03      6100
2002-07-31  37.38 37.50 37.09 37.12     29400
2002-08-01  37.59 37.60 37.38 37.38     25000
2002-08-02  37.98 38.09 37.54 37.67     52800
2002-08-05  38.15 38.24 37.98 38.06     61100
…             …     …     …     …         …
2025-11-20  89.23 89.42 88.99 88.99  32945000
2025-11-21  89.50 89.67 89.20 89.65  41938600
2025-11-24  90.01 90.07 89.78 89.95  30865700
2025-11-25  90.24 90.59 90.13 90.31  36503300
2025-11-26  90.64 90.64 89.83 90.15  34099000

[5872 rows x 5 columns]
```

[28]:

```python
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]:

```python
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   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  44.13 44.24 43.97 44.13  1754500             NaN
2004-12-31  45.30 45.35 45.17 45.21  1056400            0.03
2005-01-31  46.92 46.94 46.70 46.72  1313900            0.04
2005-02-28  46.22 46.78 46.16 46.78  2797300           -0.01
2005-03-31  46.01 46.05 45.77 45.95  2410900           -0.00

The last 5 rows are:

            Close  High   Low  Open    Volume  Monthly_Return
Date
2025-06-30  86.64 86.83 86.01 86.26  53695200            0.03
2025-07-31  85.65 86.14 85.57 85.86  49814100           -0.01
2025-08-31  85.66 85.92 85.51 85.82  41686400            0.00
2025-09-30  88.74 89.40 88.58 89.03  38584000            0.04
2025-10-31  89.96 90.33 89.88 90.23  38247300            0.01
```

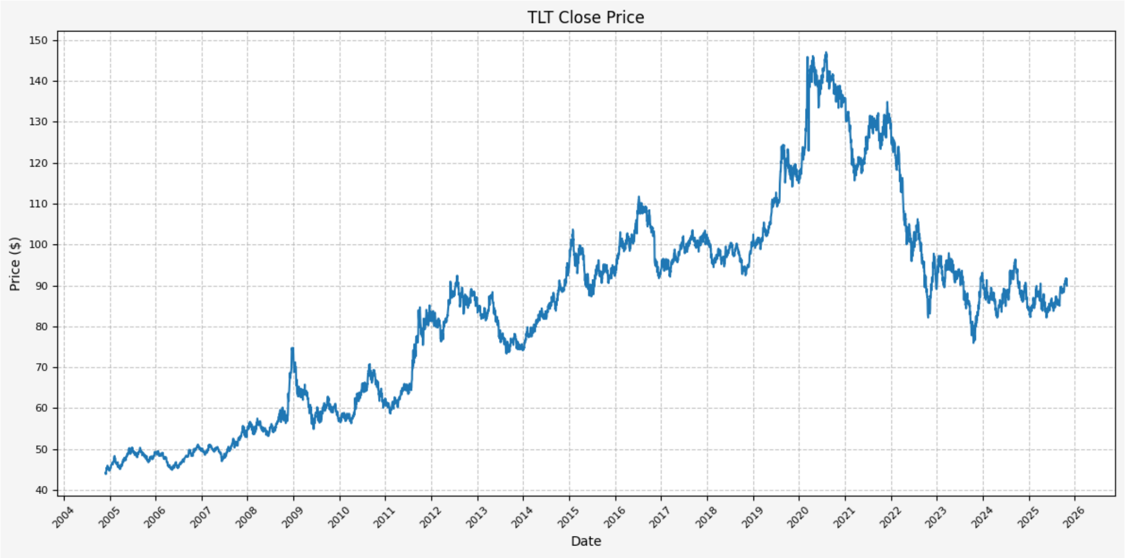
[30]:

```python
# 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]:

```python
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
```

[32]:

```
       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  2025-11-29      15              0.00

    CumulativeReturnPct  AverageMonthlyReturn  AverageMonthlyReturnPct  \
0                  4.23                  0.00                     0.25
```

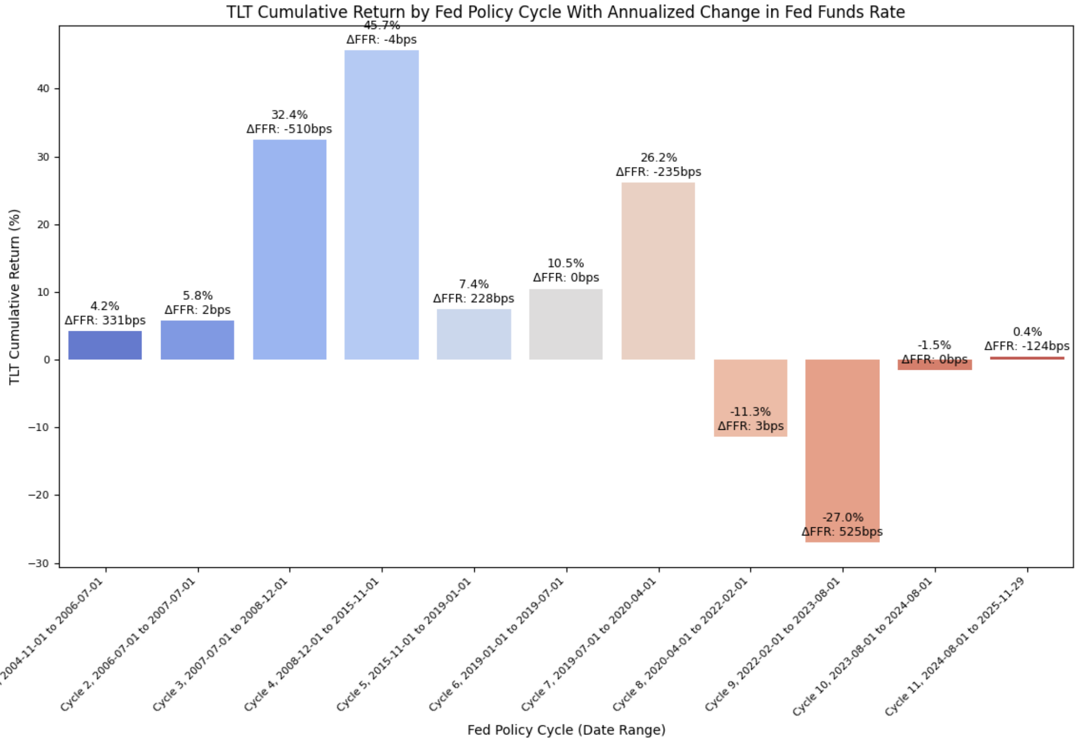
```
1                  5.76                  0.00                     0.49
2                 32.42                  0.02                     1.73
3                 45.67                  0.01                     0.55
4                  7.42                  0.00                     0.23
5                 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             -124.00                 -0.01                    -99.20

                                 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 2025-11-29
```

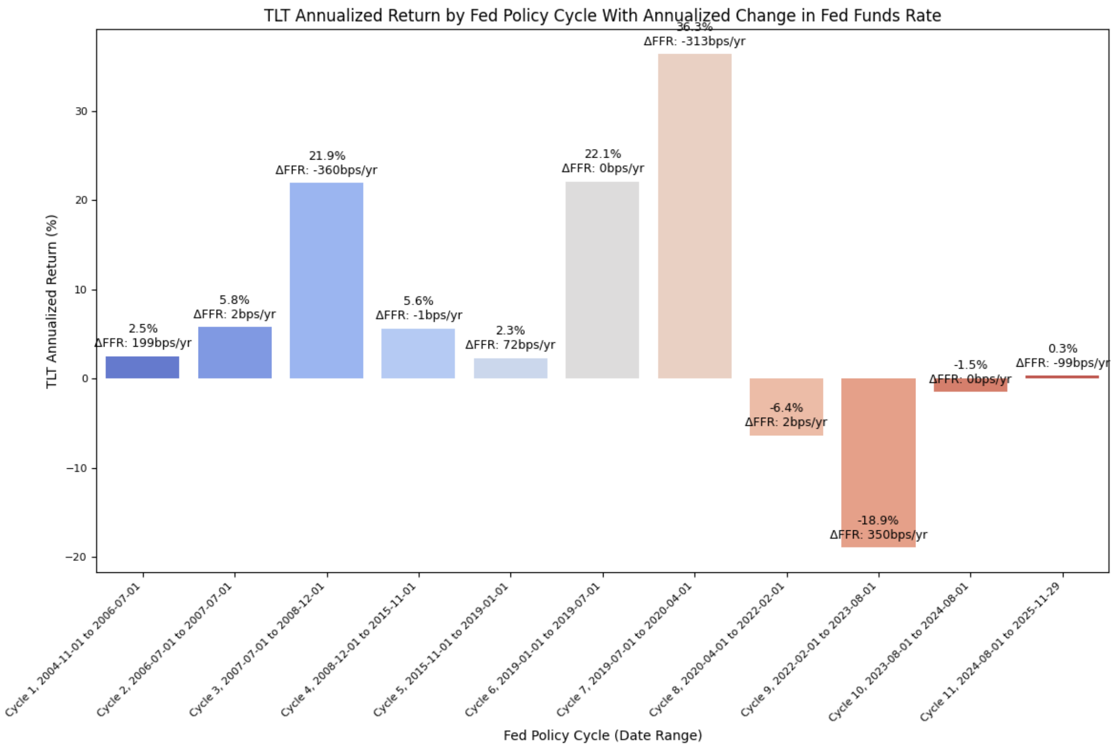
[33]:
```
# Copy this <!-- INSERT_03_TLT_Cycle_DF_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file, md_filename="03_TLT_Cycle_DF.md",␣
 ↪content=tlt_cycle_df.to_markdown(floatfmt=".2f"))
```

```
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:                       0.634
Model:                             OLS   Adj. R-squared:                  0.593
```

```
Method:                 Least Squares   F-statistic:                     15.56
Date:                Sat, 29 Nov 2025   Prob (F-statistic):            0.00338
Time:                        17:10:04   Log-Likelihood:                -39.515
No. Observations:                  11   AIC:                             83.03
Df Residuals:                       9   BIC:                             83.83
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
============
                              coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
------------
const                       5.5490      2.937      1.890      0.091      -1.094
12.192
FFR_AnnualizedChange_bps   -0.0604      0.015     -3.944      0.003      -0.095
-0.026
==============================================================================
Omnibus:                        0.797   Durbin-Watson:                   1.248
Prob(Omnibus):                  0.671   Jarque-Bera (JB):                0.712
Skew:                           0.441   Prob(JB):                        0.701
Kurtosis:                       2.121   Cond. No.                         192.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
Intercept: 5.549025934868936, Slope: -0.06038107384654423
```

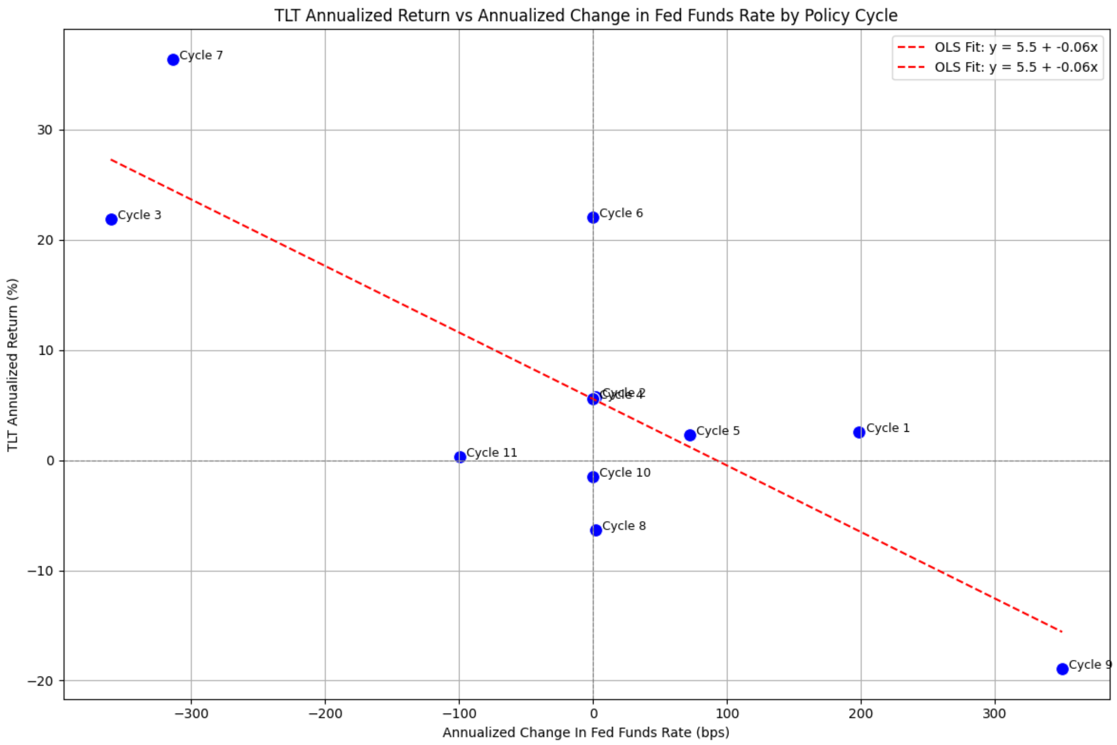
[37]:

```
# 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:

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

```
             Close    High     Low    Open   Volume
Date
2025-11-26 383.12 383.78 380.46 381.06  9184100

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
…              …       …       …       …        …
2025-11-20  374.85  377.69  371.85  375.29  10506500
2025-11-21  374.27  377.23  372.94  374.03  13194600
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

[5290 rows x 5 columns]
```

[40]:

```python
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]:

```python
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   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:

            Close   High    Low   Open    Volume  Monthly_Return
Date
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
```

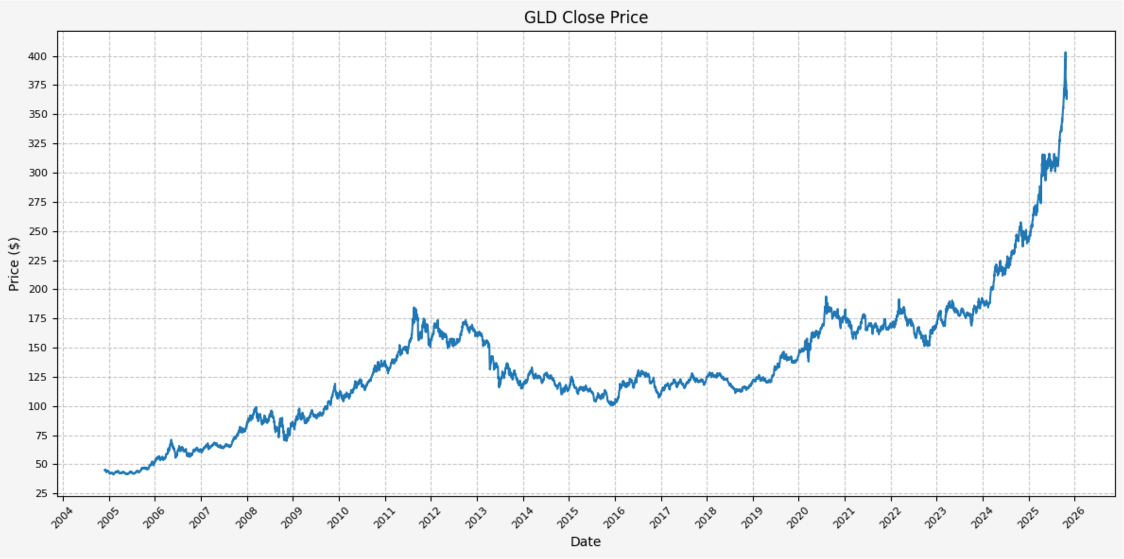
[42]:

```python
# 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]:

```python
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
```

[44]:
```
       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  2025-11-29      15              0.62

    CumulativeReturnPct  AverageMonthlyReturn  AverageMonthlyReturnPct  \
0                 35.70                  0.02                     1.73
```

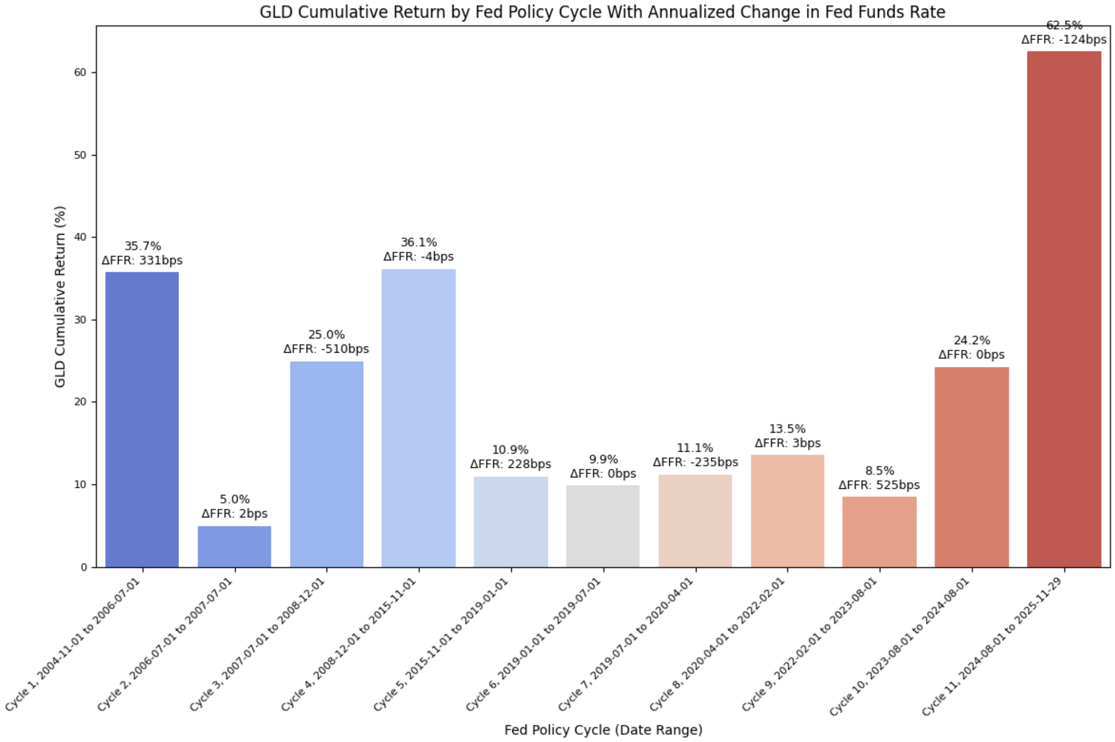
```
1                  4.96                  0.00                     0.45
2                 24.96                  0.02                     1.59
3                 36.10                  0.01                     0.51
4                 10.93                  0.00                     0.35
5                  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             -124.00                 -0.01                    -99.20

                                 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 2025-11-29
```

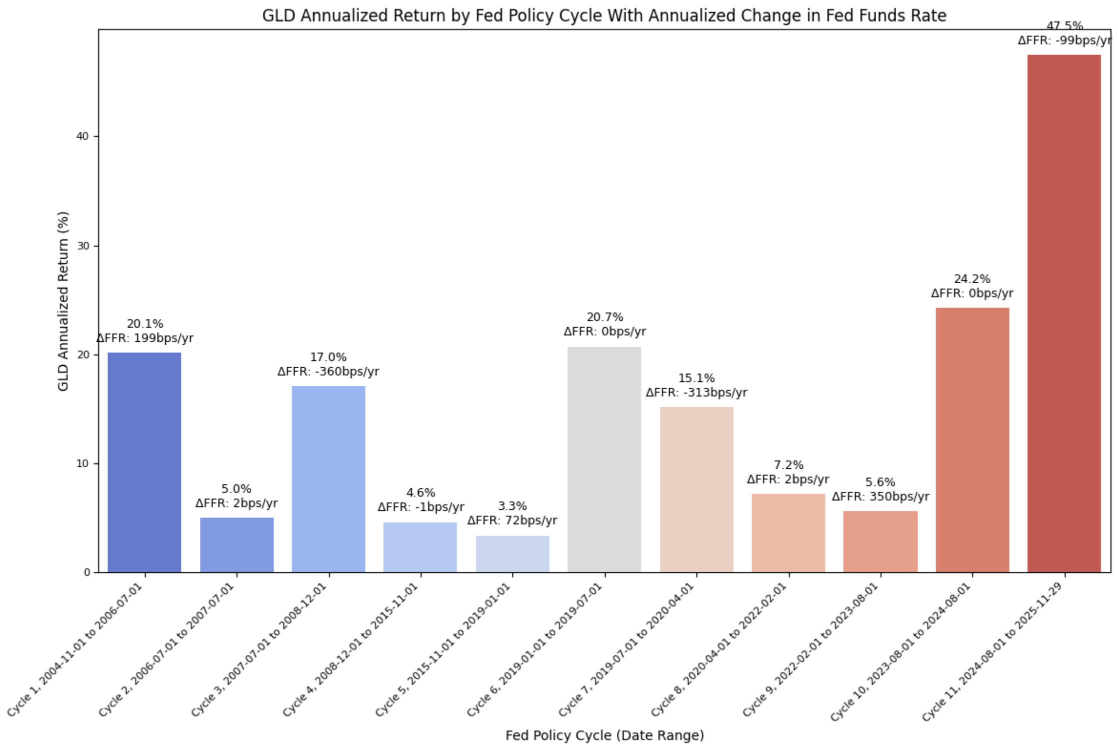
[45]:
```
# Copy this <!-- INSERT_04_GLD_Cycle_DF_HERE --> to index_temp.md
export_track_md_deps(dep_file=dep_file, md_filename="04_GLD_Cycle_DF.md", content=gld_cycle_df.to_markdown(floatfmt=".2f"))
```

```
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
```

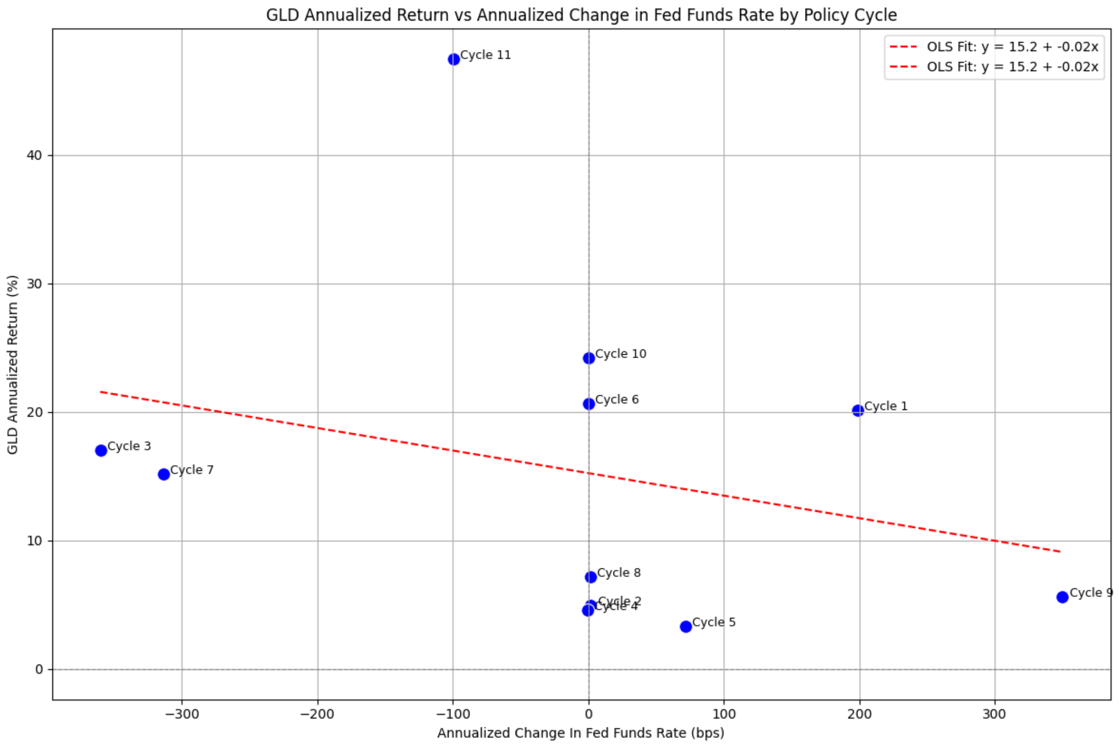
```
                              OLS Regression Results
================================================================================
Dep. Variable:      AnnualizedReturnPct   R-squared:                       0.073
Model:                              OLS   Adj. R-squared:                 -0.030
```

```
Method:                 Least Squares   F-statistic:                    0.7118
Date:                Sat, 29 Nov 2025   Prob (F-statistic):              0.421
Time:                        17:10:11   Log-Likelihood:                -42.895
No. Observations:                  11   AIC:                             89.79
Df Residuals:                       9   BIC:                             90.59
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
============
                            coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
------------
const                    15.2394      3.993      3.817      0.004       6.207
24.272
FFR_AnnualizedChange_bps   -0.0176      0.021     -0.844      0.421      -0.065
0.030
==============================================================================
Omnibus:                        8.464   Durbin-Watson:                   0.918
Prob(Omnibus):                  0.015   Jarque-Bera (JB):                3.915
Skew:                           1.356   Prob(JB):                        0.141
Kurtosis:                       4.091   Cond. No.                         192.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
Intercept: 15.239380036887518, Slope: -0.017561964787912318
```

[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', '2025-11-29')]
```

```
[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'
)

portfolio_monthly
```

```
[53]:            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
```

```
…                              …                          …
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

            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
…                        …                 …                    …
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

            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
…                  …                 …                    …
2025-06-30          0.00                0.03                   0.96
2025-07-31          0.00               -0.01                   0.94
2025-08-31          0.00                0.00                   0.94
2025-09-30          0.00                0.04                   1.01
2025-10-31          0.00                0.01                   1.04

            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
…                  …
2025-06-30         -0.41
2025-07-31         -0.41
2025-08-31         -0.41
2025-09-30         -0.39
```

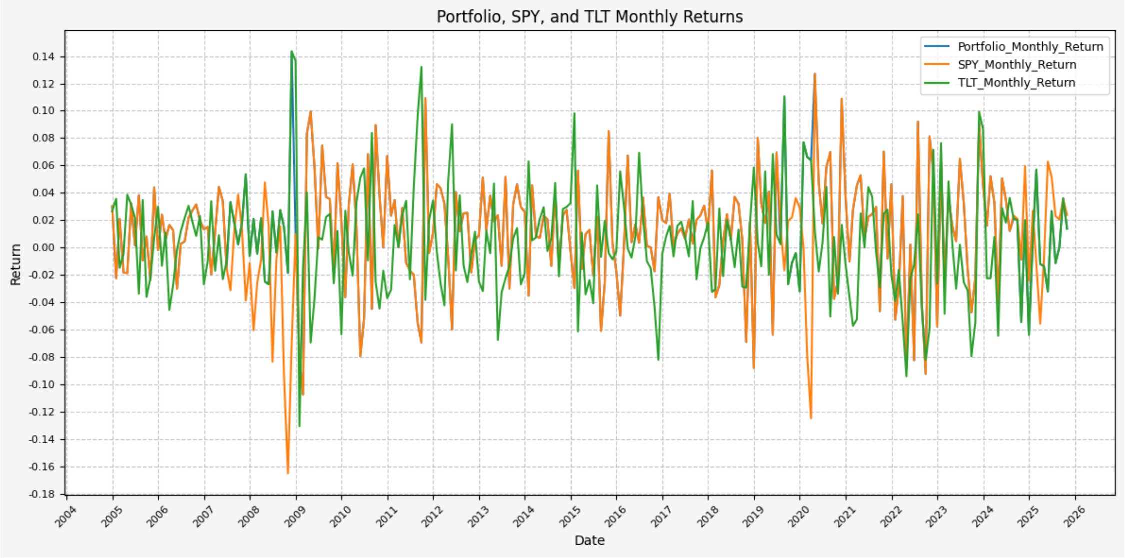
```
2025-10-31         -0.39

[252 rows x 9 columns]
```

[54]:
```
# 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=portfolio_monthly.to_markdown(floatfmt=".3f"))
```

```
Exported and tracked: 05_Portfolio_DF.md
```

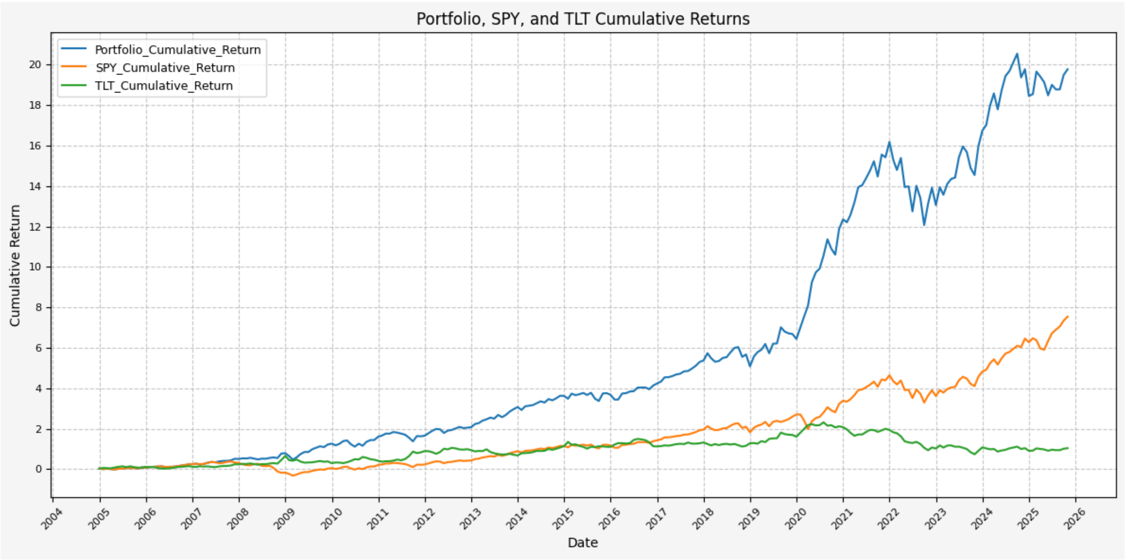
1.7.2 Performance Statistics

[55]:
```
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",
)
```



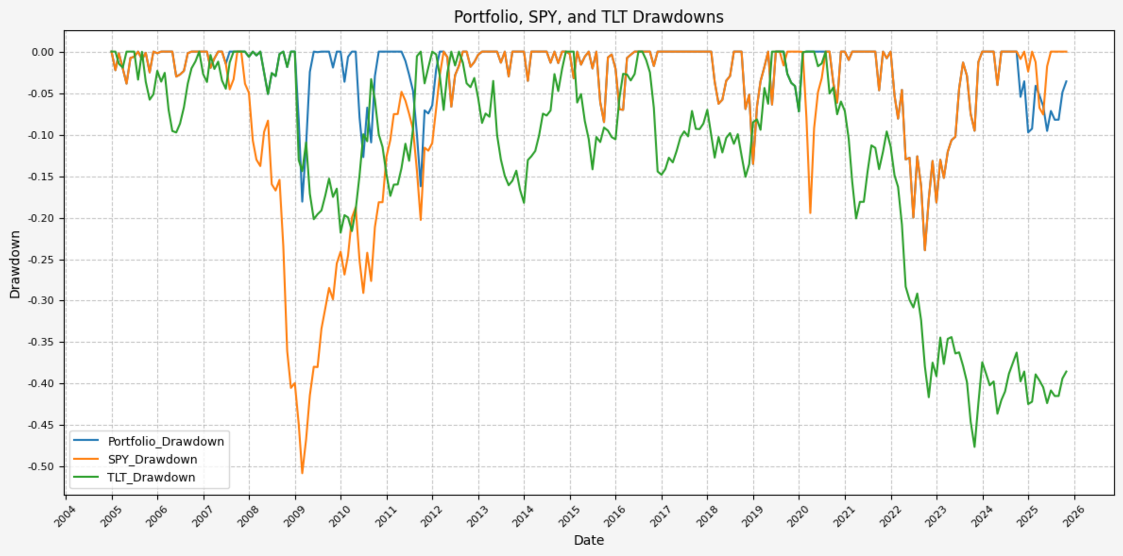
[56]:

```
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",
)
```



[57]:

```
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",
)
```



[58]:

```
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)
```

[59]:

```
# 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
```