asset-class-performance-fed-policy-cycles

January 26, 2026

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-venv-p313/lib/python3.13/site-
packages
5: /home/jared/python-virtual-envs/general-venv-p313/lib/python3.13/site-
packages/setuptools/_vendor
6:
/home/jared/Cloud_Storage/Dropbox/Websites/jaredszajkowski.github.io_congo/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:
```

DATE	FEDFUNDS	FedFunds_Change
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:
```

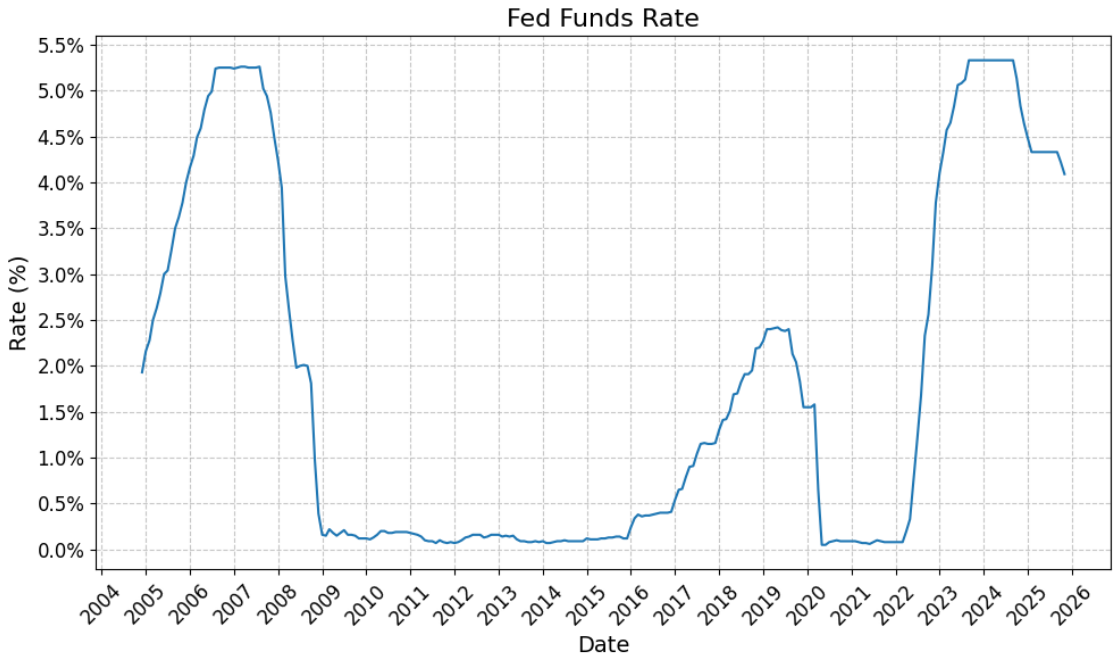
DATE	FEDFUNDS	FedFunds_Change
2025-06-30	0.0433	0.0000
2025-07-31	0.0433	0.0000
2025-08-31	0.0433	0.0000
2025-09-30	0.0422	-0.0011
2025-10-31	0.0409	-0.0013

[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),
    output_type="markdown",
)
```

```
 Exported and tracked: 01_Fed_Funds_Monthly_Rate_Change.md
```

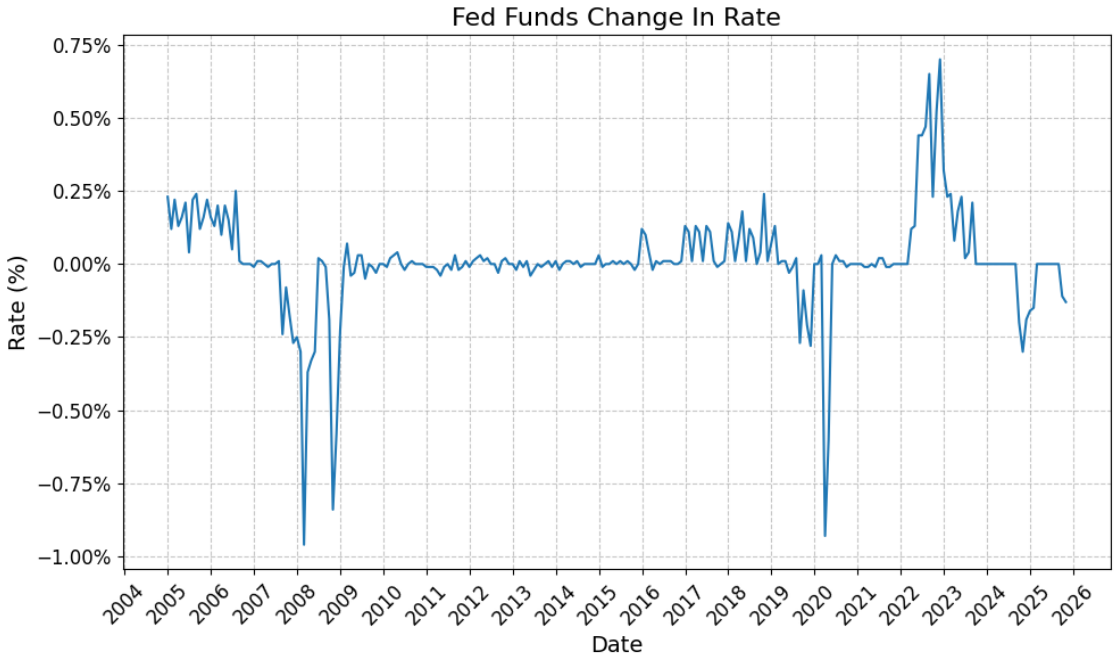
[9]:
```
plot_timeseries(
    price_df=fedfunds_monthly,
    plot_start_date=start_date,
    plot_end_date=end_date,
```

```
    plot_columns=["FEDFUNDS"],
    title="Fed Funds Rate",
    x_label="Date",
    x_format="Year",
    x_tick_rotation=45,
    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",
    x_tick_rotation=45,
    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	-0.0161

[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"),
    output_type="markdown",
)
```

```
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  24.24 24.26 24.14 24.26  1003200

            Close   High    Low   Open    Volume
Date
2026-01-23 689.23 690.96 687.16 688.15  63016300

Yahoo Finance data complete for SPY
--------------------
```

[15]:

Date	Close	High	Low	Open	Volume
1993-01-29	24.24	24.26	24.14	24.26	1003200
1993-02-01	24.41	24.41	24.26	24.26	480500
1993-02-02	24.47	24.48	24.34	24.40	201300
1993-02-03	24.72	24.74	24.48	24.50	529400
1993-02-04	24.83	24.88	24.53	24.81	531500
…	…	…	…	…	…
2026-01-16	691.66	694.25	690.10	693.66	79289200
2026-01-20	677.58	684.77	676.57	681.49	111623300
2026-01-21	685.40	688.74	678.13	679.65	127844500
2026-01-22	688.98	691.13	686.92	689.85	77112200
2026-01-23	689.23	690.96	687.16	688.15	63016300

[8303 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:
```

Date	Close	High	Low	Open	Volume	Monthly_Return
2004-11-30	79.60	79.83	79.43	79.67	53685200	NaN
2004-12-31	81.99	82.53	81.95	82.28	28648800	0.03
2005-01-31	80.15	80.22	79.85	80.01	52532700	-0.02
2005-02-28	81.83	82.28	81.43	82.18	69381300	0.02
2005-03-31	80.33	80.67	80.27	80.49	64575400	-0.02

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

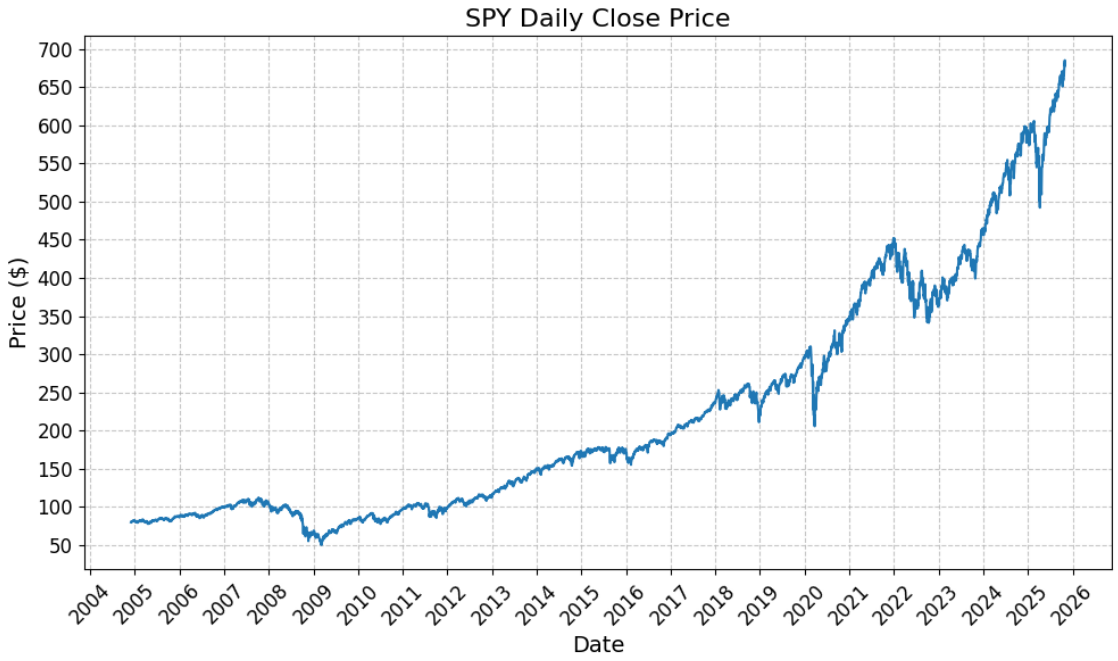
Date	Close	High	Low	Open	Volume	Monthly_Return
2025-06-30	614.33	615.69	611.53	613.86	92502500	0.05
2025-07-31	628.48	636.20	627.17	635.81	103385200	0.02
2025-08-31	641.37	644.15	639.47	643.78	74522200	0.02
2025-09-30	664.22	664.69	659.66	660.98	86288000	0.04
2025-10-31	680.05	683.06	677.24	683.02	87164100	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),
    output_type="markdown",
)
```

```
 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 Daily Close Price",
    x_label="Date",
    x_format="Year",
    x_tick_rotation=45,
    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	CumulativeReturnPct	AverageMonthlyReturn	AverageMonthlyReturnPct	AnnualizedReturn	AnnualizedReturnPct	Volatility	FedFundsChange	FedFundsChange_bps	FFR_AnnualizedChange	FFR_AnnualizedChange_bps
0	Cycle 1	2004-11-01	2006-07-01	20	0.11	11.32	0.01	0.59	0.07	6.64	0.08	0.03	331.00	0.02	198.60
1	Cycle 2	2006-07-01	2007-07-01	12	0.20	20.36	0.02	1.57	0.20	20.36	0.07	0.00	2.00	0.00	2.00
2	Cycle 3	2007-07-01	2008-12-01	17	-0.39	-38.55	-0.03	-2.67	-0.29	-29.09	0.19	-0.05	-510.00	-0.04	-360.00
3	Cycle 4	2008-12-01	2015-11-01	83	1.67	167.34	0.01	1.28	0.15	15.28	0.15	-0.00	-4.00	-0.00	-0.58
4	Cycle 5	2015-11-01	2019-01-01	38	0.28	28.30	0.01	0.70	0.08	8.19	0.11	0.02	228.00	0.01	72.00
5	Cycle 6	2019-01-01	2019-07-01	6	0.18	18.33	0.03	2.95	0.40	40.01	0.18	0.00	0.00	0.00	0.00
6	Cycle 7	2019-07-01	2020-04-01	9	-0.11	-10.67	-0.01	-1.10	-0.14	-13.96	0.19	-0.02	-235.00	-0.03	-313.33
7	Cycle 8	2020-04-01	2022-02-01	22	0.79	79.13	0.03	2.78	0.37	37.43	0.16	0.00			
8	Cycle 9	2022-02-01	2023-08-01	18	0.04	4.18	0.00	0.40	0.03	2.77	0.21	0.05			
9	Cycle 10	2023-08-01	2024-08-01	12	0.22	22.00	0.02	1.75	0.22	22.00	0.15	0.00			
10	Cycle 11	2024-08-01	2026-01-26	15	0.26	25.72	0.02	1.59	0.20	20.09	0.11	-0.02			

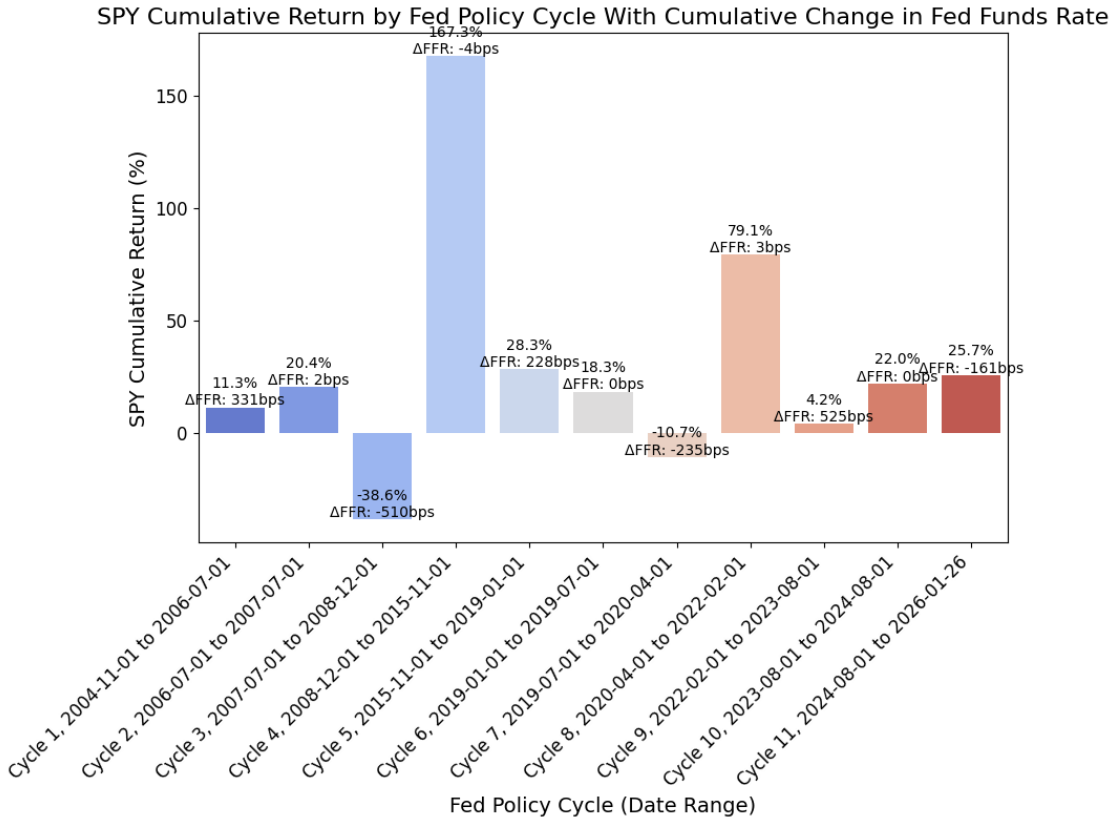
7	3.00	0.00	1.64
8	525.00	0.03	350.00
9	0.00	0.00	0.00
10	-161.00	-0.01	-128.80

	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 2026-01-26

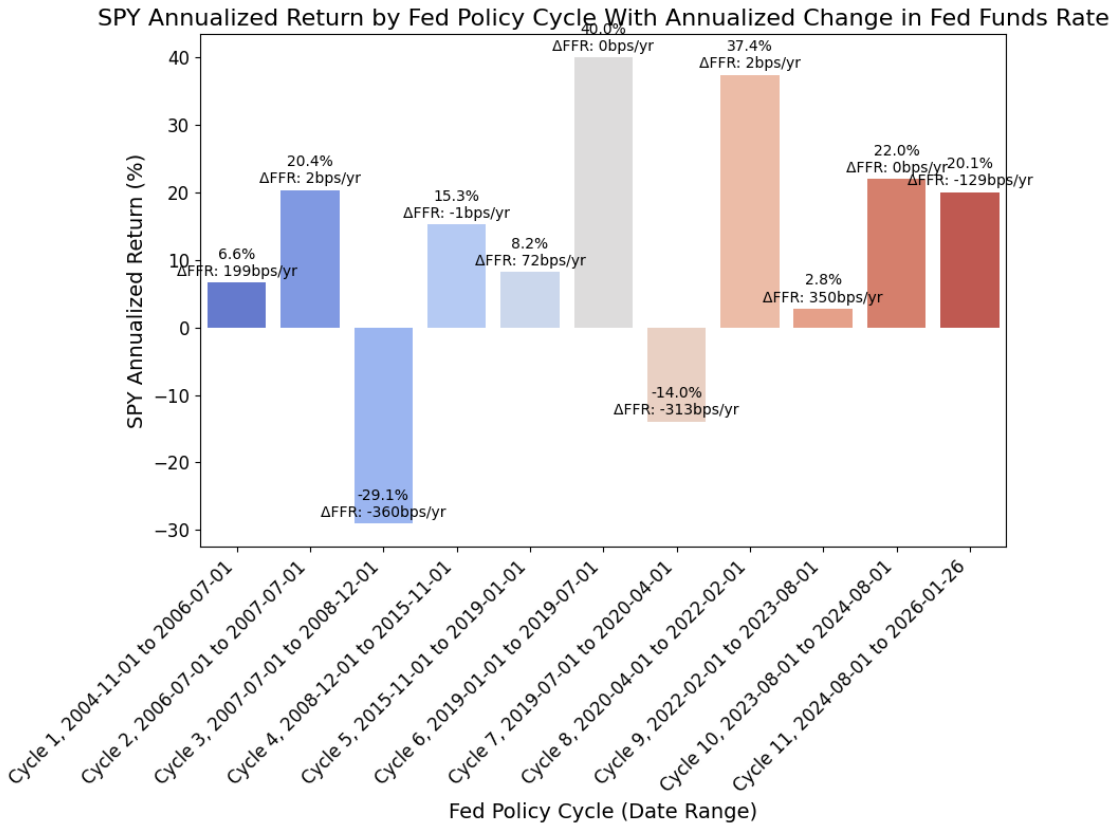
[21]:
```
# Copy this <!-- INSERT_02_SPY_Cycle_DF_HERE --> to index_temp.md
export_track_md_deps(
    dep_file=dep_file,
    md_filename="02_SPY_Cycle_DF.md",
    content=spy_cycle_df.to_markdown(floatfmt=".2f"),
    output_type="markdown",
)
```

```
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
==============================================================================
```

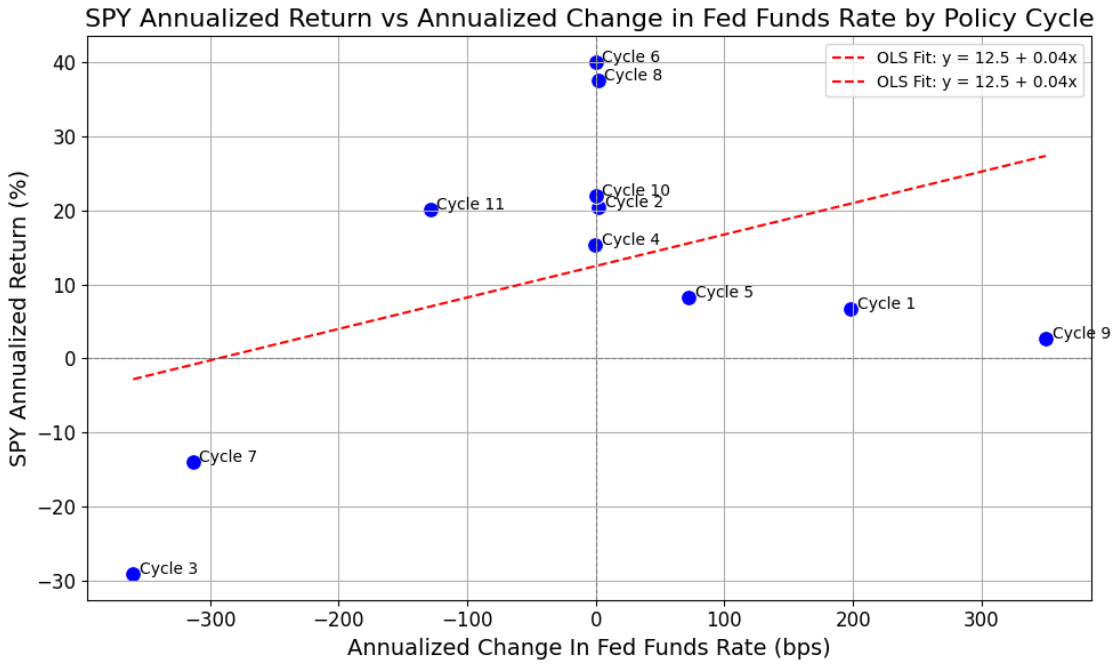
```
Dep. Variable:     AnnualizedReturnPct   R-squared:                       0.176
Model:                             OLS   Adj. R-squared:                  0.085
Method:                  Least Squares   F-statistic:                     1.928
Date:                 Mon, 26 Jan 2026   Prob (F-statistic):              0.198
Time:                         12:06:34   Log-Likelihood:                -47.196
No. Observations:                   11   AIC:                             98.39
Df Residuals:                        9   BIC:                             99.19
Df Model:                            1
Covariance Type:             nonrobust
================================================================================
============
                                 coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
------------
const                         12.4815      5.909      2.112      0.064      -0.886
25.849
FFR_AnnualizedChange_bps       0.0424      0.031      1.389      0.198      -0.027
0.112
==============================================================================
Omnibus:                        1.103   Durbin-Watson:                   3.070
Prob(Omnibus):                  0.576   Jarque-Bera (JB):                0.674
Skew:                           0.021   Prob(JB):                        0.714
Kurtosis:                       1.788   Cond. No.                         194.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
Intercept: 12.481508545114949, Slope: 0.04242618089044424
```

[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"),
    output_type="text",
)
```

```
 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:

            Close  High   Low  Open  Volume
Date
```

```
2002-07-30  36.65 36.82 36.65 36.75    6100

            Close  High   Low  Open    Volume
Date
2026-01-23  87.93 88.03 87.50 87.83  35959500

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

[27]:

Date	Close	High	Low	Open	Volume
2002-07-30	36.65	36.82	36.65	36.75	6100
2002-07-31	37.10	37.22	36.82	36.84	29400
2002-08-01	37.31	37.32	37.11	37.11	25000
2002-08-02	37.70	37.81	37.26	37.39	52800
2002-08-05	37.86	37.96	37.70	37.78	61100
…	…	…	…	…	…
2026-01-16	87.80	88.32	87.71	88.13	46382400
2026-01-20	86.65	87.03	86.54	86.63	66009500
2026-01-21	87.31	87.48	86.62	86.80	51220100
2026-01-22	87.69	87.76	87.14	87.27	42419300
2026-01-23	87.93	88.03	87.50	87.83	35959500

[5910 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:
```

Date	Close	High	Low	Open	Volume	Monthly_Return
2004-11-30	43.80	43.91	43.64	43.80	1754500	NaN
2004-12-31	44.96	45.01	44.84	44.87	1056400	0.03
2005-01-31	46.57	46.59	46.35	46.37	1313900	0.04
2005-02-28	45.88	46.43	45.82	46.43	2797300	-0.01
2005-03-31	45.67	45.70	45.43	45.61	2410900	-0.00

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

Date	Close	High	Low	Open	Volume	Monthly_Return
2025-06-30	86.00	86.18	85.37	85.62	53695200	0.03
2025-07-31	85.02	85.50	84.94	85.22	49814100	-0.01
2025-08-31	85.03	85.28	84.87	85.18	41686400	0.00
2025-09-30	88.08	88.74	87.92	88.37	38584000	0.04
2025-10-31	89.30	89.66	89.21	89.56	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),
    output_type="markdown",
)
```

```
 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 Daily Close Price",
    x_label="Date",
    x_format="Year",
```

```
    x_tick_rotation=45,
    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	2026-01-26	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	-0.02

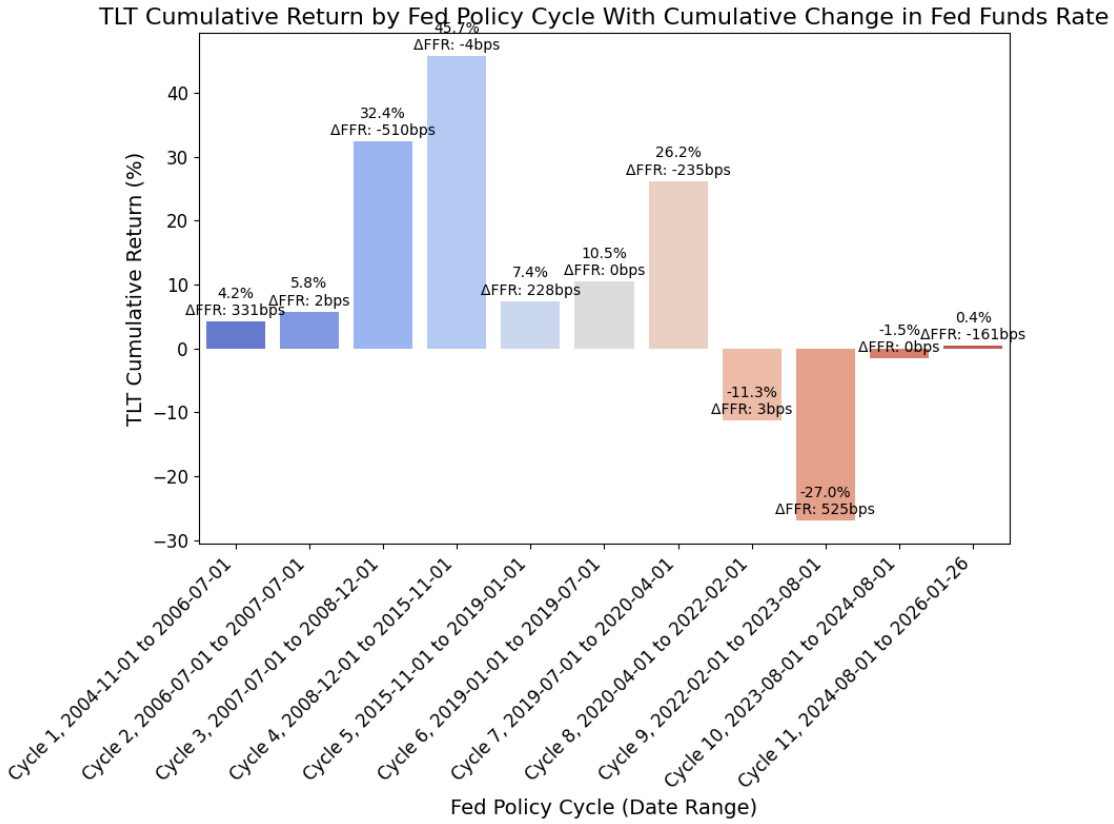
	FedFundsChange_bps	FFR_AnnualizedChange	FFR_AnnualizedChange_bps
0	331.00	0.02	198.60
1	2.00	0.00	2.00
2	-510.00	-0.04	-360.00
3	-4.00	-0.00	-0.58
4	228.00	0.01	72.00
5	0.00	0.00	0.00
6	-235.00	-0.03	-313.33
7	3.00	0.00	1.64
8	525.00	0.03	350.00
9	0.00	0.00	0.00
10	-161.00	-0.01	-128.80

```
                                  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 2026-01-26
```

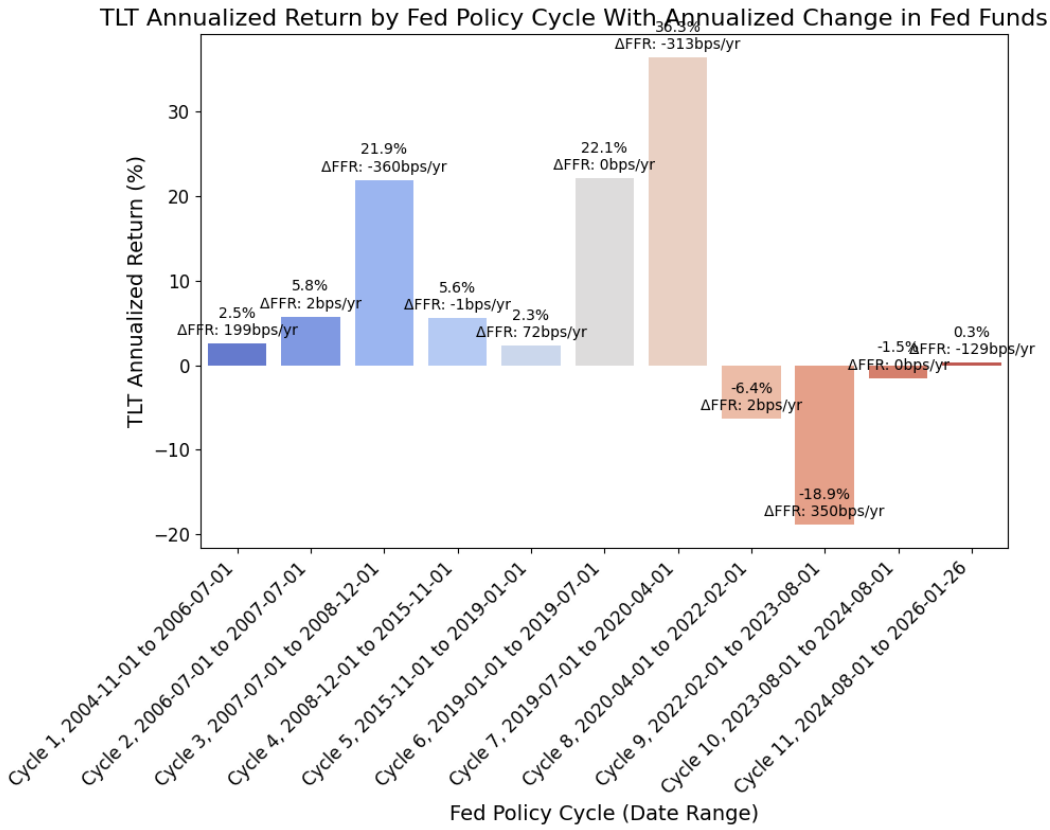
[33]:
```
# Copy this <!-- INSERT_03_TLT_Cycle_DF_HERE --> to index_temp.md
export_track_md_deps(
    dep_file=dep_file,
    md_filename="03_TLT_Cycle_DF.md",
    content=tlt_cycle_df.to_markdown(floatfmt=".2f"),
    output_type="markdown",
)
```

```
 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
==============================================================================
```

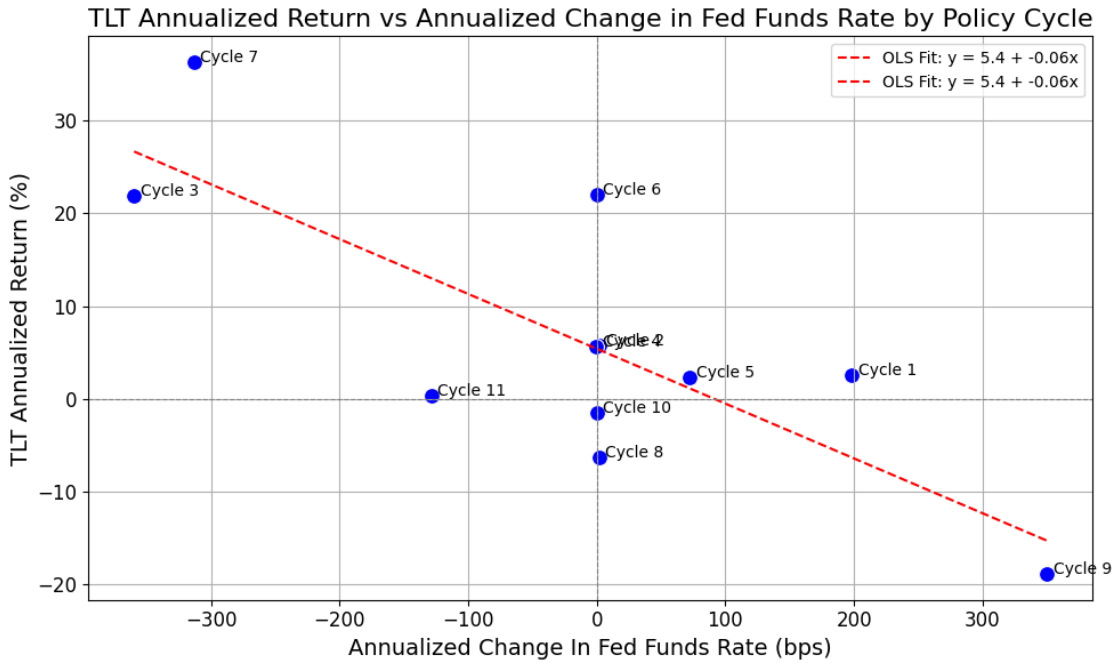
```
Dep. Variable:     AnnualizedReturnPct   R-squared:                       0.615
Model:                             OLS   Adj. R-squared:                  0.573
Method:                  Least Squares   F-statistic:                     14.39
Date:                 Mon, 26 Jan 2026   Prob (F-statistic):           0.00426
Time:                         12:06:37   Log-Likelihood:                -39.782
No. Observations:                   11   AIC:                             83.56
Df Residuals:                        9   BIC:                             84.36
Df Model:                            1
Covariance Type:             nonrobust
================================================================================
============
                                 coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
------------
const                          5.4077      3.012      1.796      0.106      -1.405
12.221
FFR_AnnualizedChange_bps      -0.0591      0.016     -3.794      0.004      -0.094
-0.024
==============================================================================
Omnibus:                        0.635   Durbin-Watson:                   1.199
Prob(Omnibus):                  0.728   Jarque-Bera (JB):                0.621
Skew:                           0.387   Prob(JB):                        0.733
Kurtosis:                       2.131   Cond. No.                         194.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
Intercept: 5.407713843801814, Slope: -0.059076861433875985
```

[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"),
    output_type="text",
)
```

```
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
2026-01-23 458.00 458.75 453.45 454.11  21497000
```

```
Yahoo Finance data complete for GLD
--------------------
```

[39]:

Date	Close	High	Low	Open	Volume
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
…	…	…	…	…	…
2026-01-16	421.29	424.80	417.04	422.80	20951600
2026-01-20	437.23	438.14	434.10	436.69	21308100
2026-01-21	443.60	448.00	437.11	446.87	38830200
2026-01-22	451.79	452.98	443.56	443.84	19251200
2026-01-23	458.00	458.75	453.45	454.11	21497000

[5328 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   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	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:

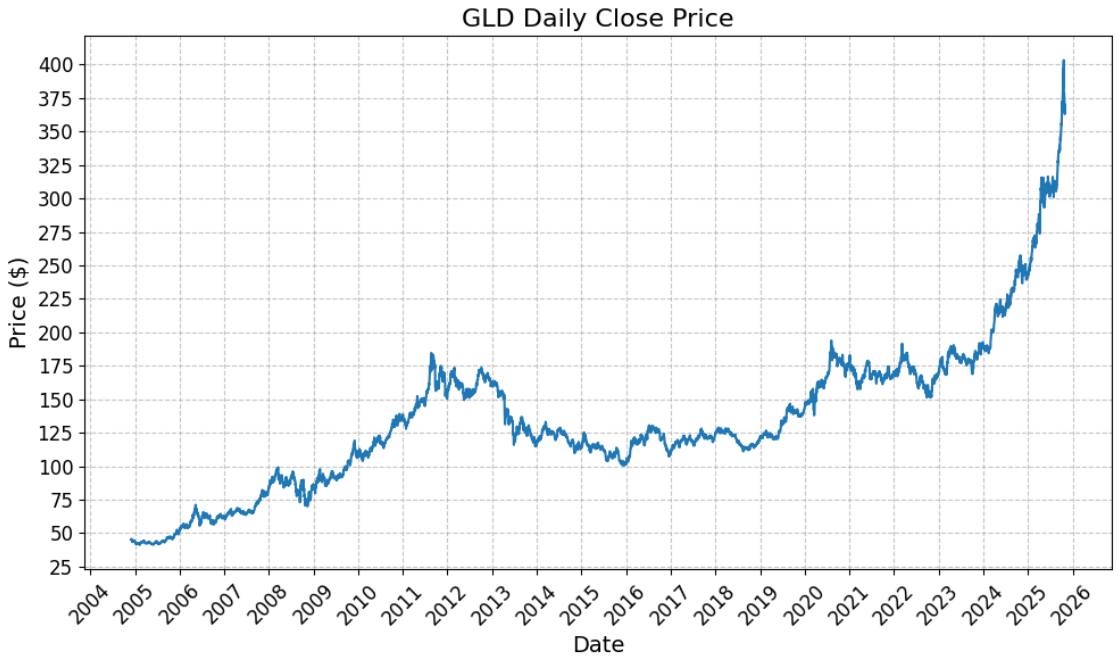
Date	Close	High	Low	Open	Volume	Monthly_Return
2025-06-30	304.83	304.92	301.95	302.39	8192100	0.00
2025-07-31	302.96	304.61	302.86	304.59	8981000	-0.01
2025-08-31	318.07	318.09	314.64	314.72	15642600	0.05
2025-09-30	355.47	355.57	350.87	351.13	13312400	0.12
2025-10-31	368.12	370.66	365.50	370.47	11077900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

[42]:
```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),
    output_type="markdown",
)
```

```
 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 Daily Close Price",
    x_label="Date",
    x_format="Year",
```

```
    x_tick_rotation=45,
    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	2026-01-26	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	-0.02	

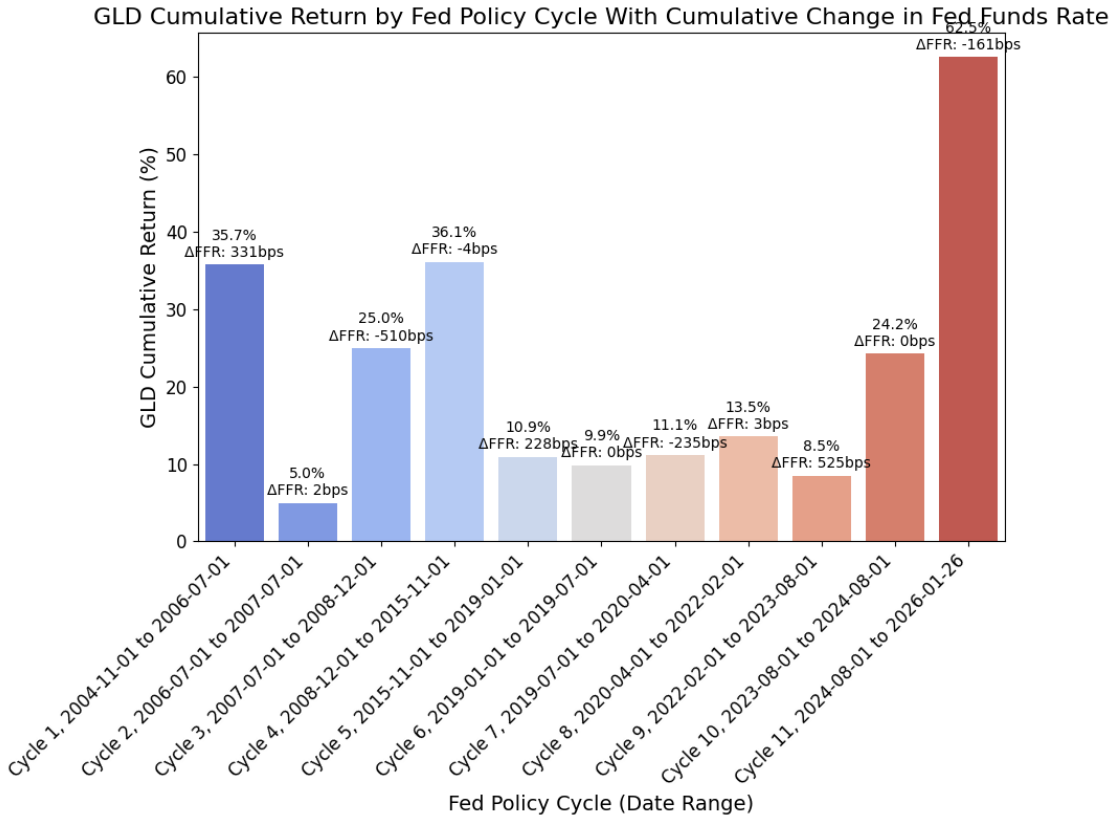
	FedFundsChange_bps	FFR_AnnualizedChange	FFR_AnnualizedChange_bps	\
0	331.00	0.02	198.60	
1	2.00	0.00	2.00	
2	-510.00	-0.04	-360.00	
3	-4.00	-0.00	-0.58	
4	228.00	0.01	72.00	
5	0.00	0.00	0.00	
6	-235.00	-0.03	-313.33	
7	3.00	0.00	1.64	
8	525.00	0.03	350.00	
9	0.00	0.00	0.00	
10	-161.00	-0.01	-128.80	

```
                                  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 2026-01-26
```

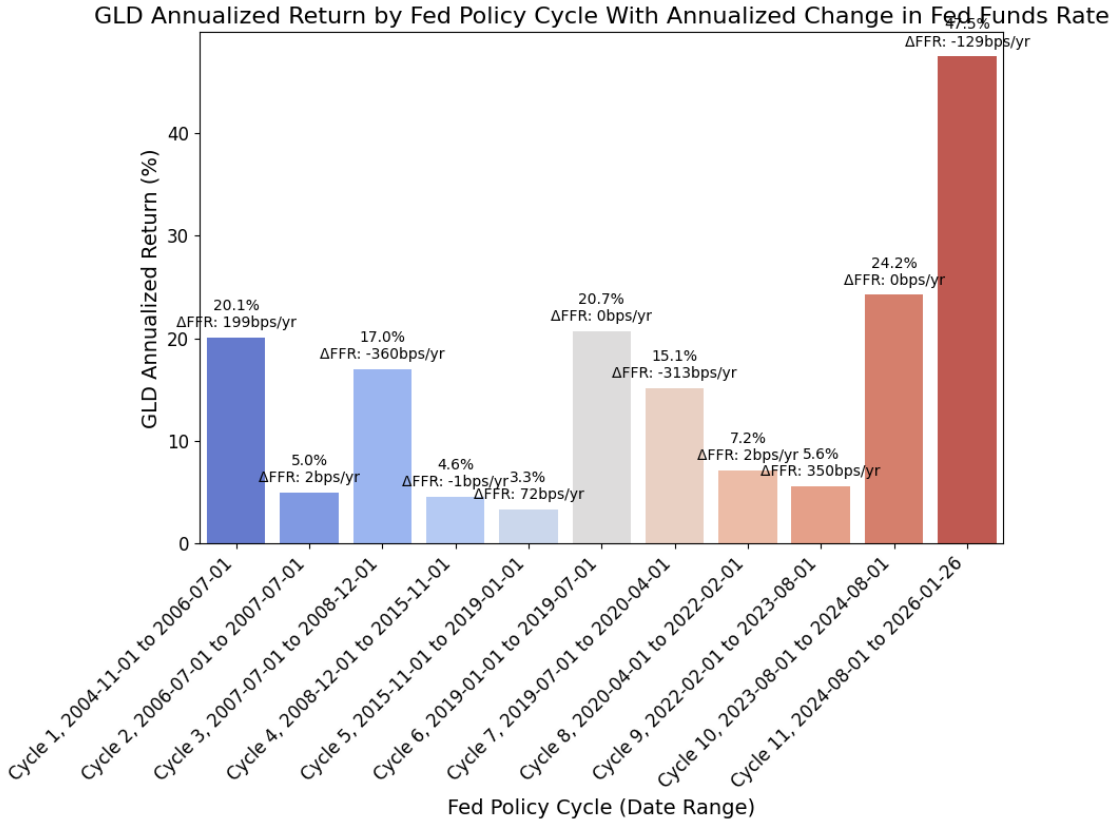
[45]:
```
# Copy this <!-- INSERT_04_GLD_Cycle_DF_HERE --> to index_temp.md
export_track_md_deps(
    dep_file=dep_file,
    md_filename="04_GLD_Cycle_DF.md",
    content=gld_cycle_df.to_markdown(floatfmt=".2f"),
    output_type="markdown",
)
```

```
 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
==============================================================================
```

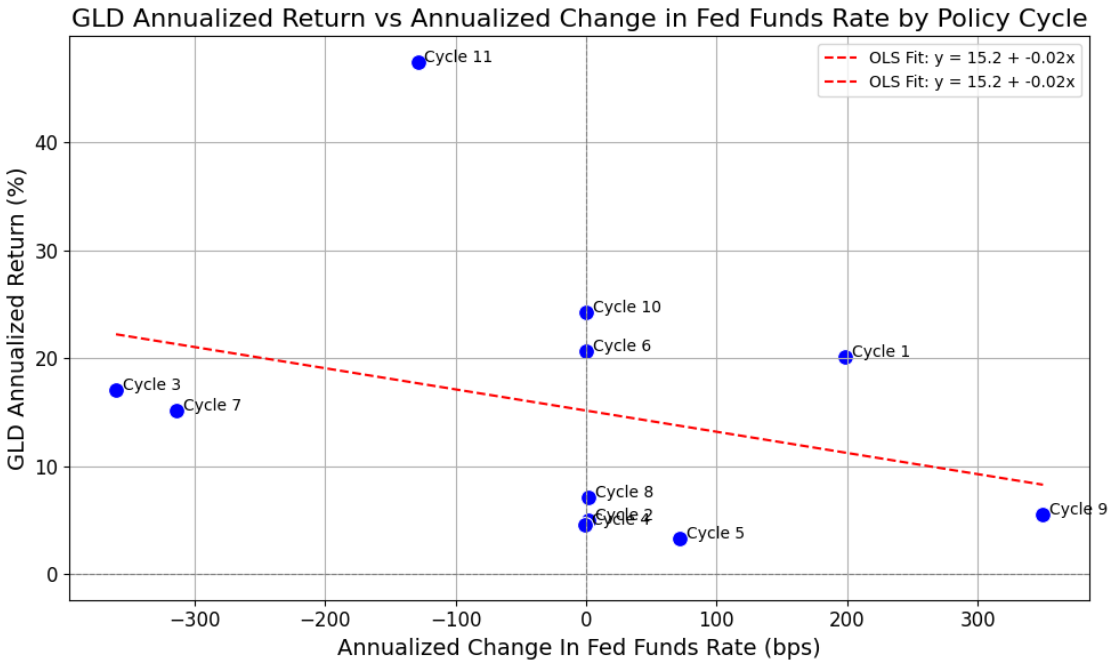
```
Dep. Variable:     AnnualizedReturnPct   R-squared:                       0.093
Model:                             OLS   Adj. R-squared:                 -0.008
Method:                  Least Squares   F-statistic:                    0.9214
Date:                 Mon, 26 Jan 2026   Prob (F-statistic):              0.362
Time:                         12:06:40   Log-Likelihood:                -42.778
No. Observations:                   11   AIC:                             89.56
Df Residuals:                        9   BIC:                             90.35
Df Model:                            1
Covariance Type:             nonrobust
================================================================================
============
                                 coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
------------
const                         15.1586      3.955      3.833      0.004       6.213
24.104
FFR_AnnualizedChange_bps      -0.0196      0.020     -0.960      0.362      -0.066
0.027
==============================================================================
Omnibus:                        7.682   Durbin-Watson:                   0.913
Prob(Omnibus):                  0.021   Jarque-Bera (JB):                3.504
Skew:                           1.305   Prob(JB):                        0.173
Kurtosis:                       3.912   Cond. No.                         194.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly
specified.
Intercept: 15.158628269088016, Slope: -0.019626313878624208
```

[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"),
    output_type="text",
)
```

```
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', '2026-01-26')]
```

[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:
```

Date	Portfolio_Monthly_Return	Portfolio_Cumulative_Return	\
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	

Date	Portfolio_Drawdown	SPY_Monthly_Return	SPY_Cumulative_Return	\
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	

Date	SPY_Drawdown	TLT_Monthly_Return	TLT_Cumulative_Return	\
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	

Date	TLT_Drawdown
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
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
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
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
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
```

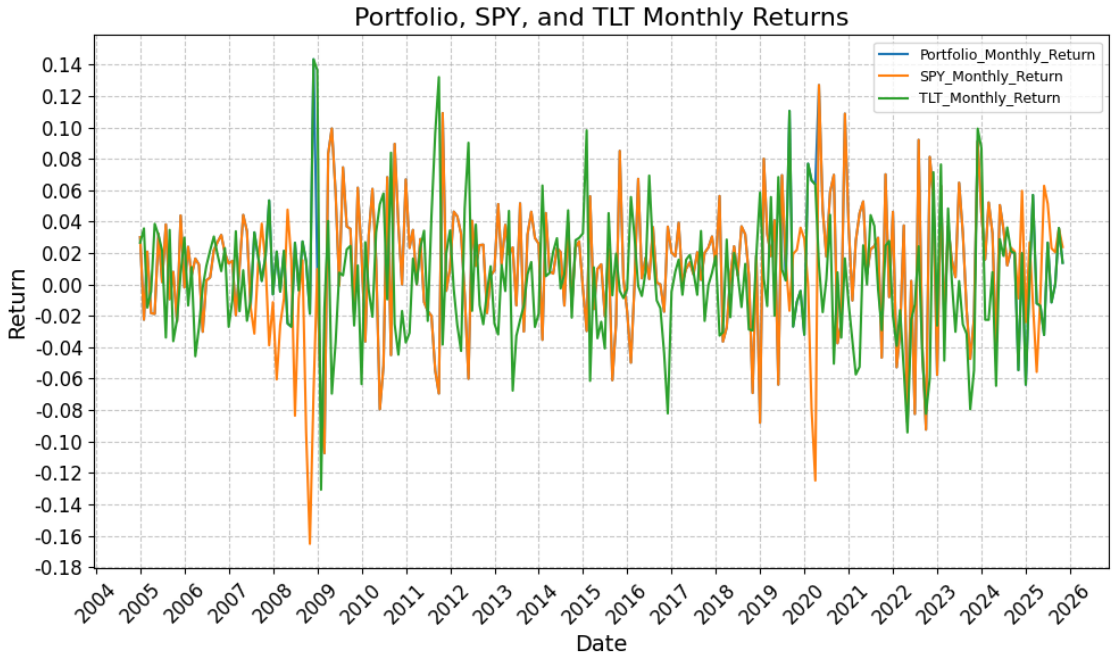
[55]:
```
# Copy this <!-- INSERT_05_Portfolio_DF_HERE --> to index_temp.md
export_track_md_deps(
    dep_file=dep_file,
    md_filename="05_Portfolio_DF.md",
    content=df_info_markdown(df=portfolio_monthly, decimal_places=3),
    output_type="markdown",
)
```

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

1.7.2 Performance Statistics

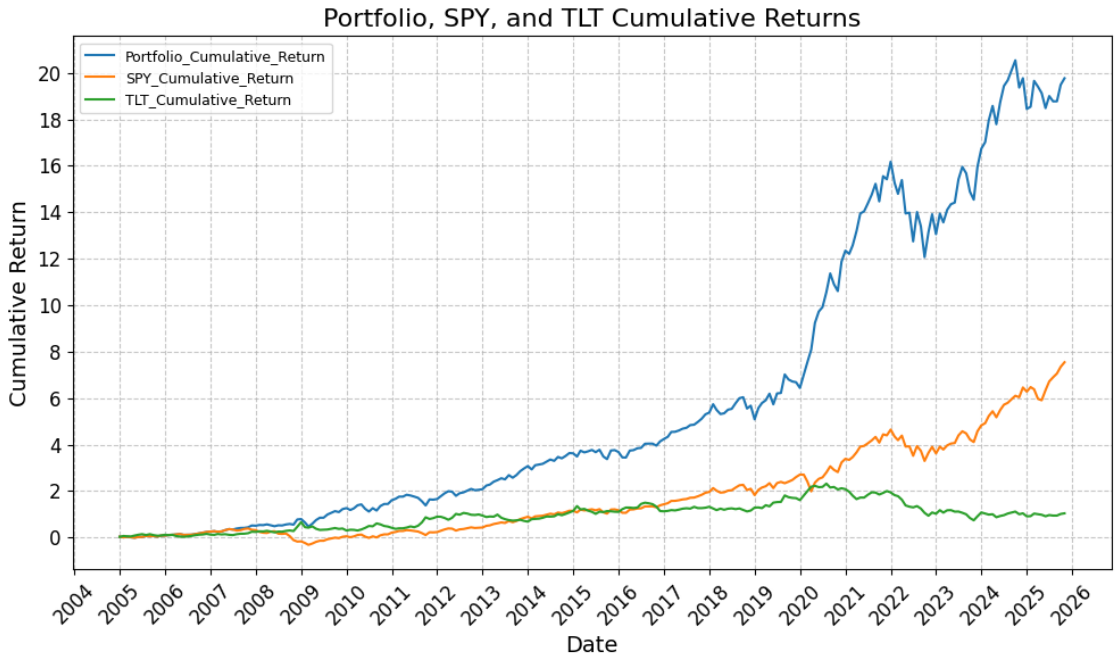
[56]:
```
plot_timeseries(
    price_df=portfolio_monthly,
    plot_start_date=start_date,
    plot_end_date=end_date,
```

```
    plot_columns=["Portfolio_Monthly_Return", "SPY_Monthly_Return",␣
 ↪"TLT_Monthly_Return"],
    title="Portfolio, SPY, and TLT Monthly Returns",
    x_label="Date",
    x_format="Year",
    x_tick_rotation=45,
    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",
)
```



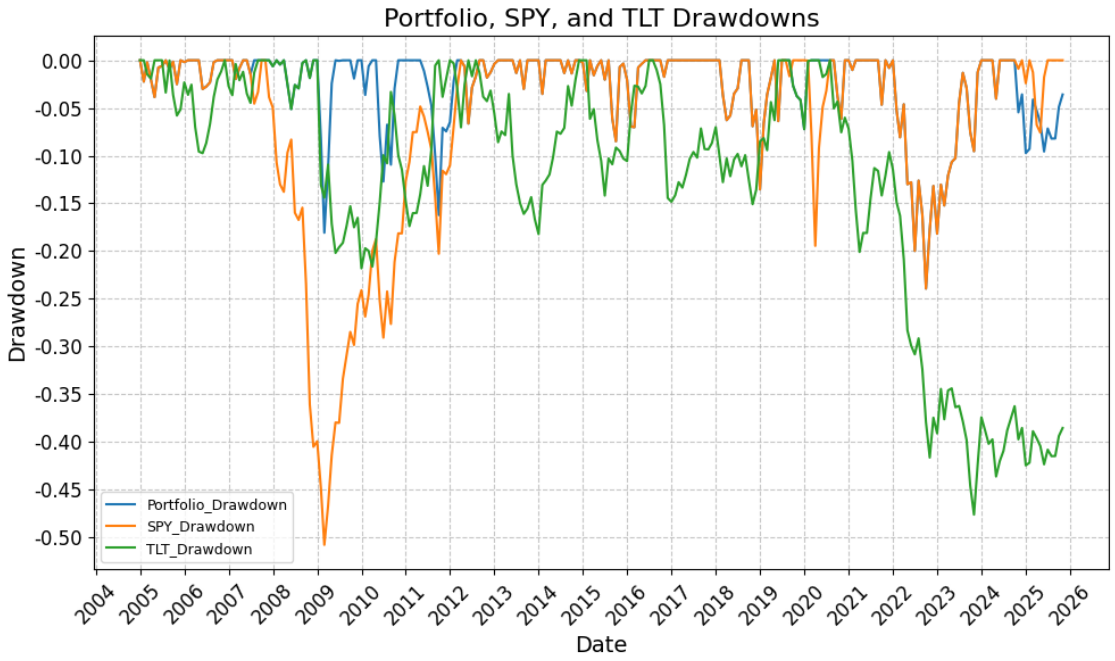
[57]:
```
plot_timeseries(
    price_df=portfolio_monthly,
    plot_start_date=start_date,
    plot_end_date=end_date,
    plot_columns=["Portfolio_Cumulative_Return", "SPY_Cumulative_Return",␣
 ↪"TLT_Cumulative_Return"],
    title="Portfolio, SPY, and TLT Cumulative Returns",
    x_label="Date",
    x_format="Year",
```

```
    x_tick_rotation=45,
    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",
    x_tick_rotation=45,
    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"),
    output_type="markdown",
)
```

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

[ ]:
```

```