leveraged-etfs-returns-dispersion

March 16, 2026

0.1 Introduction

Over the past 15 years (or so), leveraged ETFs have become a frequently used vehicle for trading equity indices, sectors, and other asset classes for the investor that is seeking to use leverage to amply their returns. The question remains, however, what happens to the returns of leveraged ETFs over extended time horizon? And is there an optimal leverage ratio for the long term buy-and-hold investor that allows them to take advantage of leverage to amply the upside, while avoiding catastrophic losses on the down side? In this investigation, we will delve into these ideas and see what the data shows.

Python Imports

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

from pathlib import Path

# Data Handling
import pandas as pd

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

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
```

```python
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")
```

0.2 Python Functions

Here are the functions needed for this project:

- load_data: Load data from a CSV, Excel, or Pickle file into a pandas DataFrame.
- pandas_set_decimal_places: Set the number of decimal places displayed for floating-point numbers in pandas.
- plot_histogram: Plot the histogram of a data set from a DataFrame.
- plot_scatter: Plot the data from a DataFrame for a specified date range and columns.
- plot_timeseries: Plot the timeseries data from a DataFrame for a specified date range and columns.
- run_linear_regression: Run a linear regression using statsmodels OLS and return the results.
- summary_stats: Generate summary statistics for a series of returns.
- yf_pull_data: Download daily price data from Yahoo Finance and export it.

[3]:
```python
from load_data import load_data
from pandas_set_decimal_places import pandas_set_decimal_places
from plot_histogram import plot_histogram
from plot_scatter import plot_scatter
from plot_timeseries import plot_timeseries
from run_linear_regression import run_linear_regression
from summary_stats import summary_stats
from yf_pull_data import yf_pull_data
```

0.3 Data Overview

For this exercise, we will investigate the long-term return relationships between the following:

- QQQ (Invesco QQQ Trust, Series 1) and TQQQ (ProShares UltraPro QQQ)
- SPY (SPDR S&P 500 ETF Trust) and UPRO (ProShares UltraPro S&P 500)

Just to clarify, any time we are referring to "close prices" in this analysis, we are referring to the partially-adjusted close prices that account for splits, but not dividends. Because we are dealing with leveraged ETFs, we want to focus on the pure returns due to change in price, but exclude the dividends, which are not leveraged in the same way as the price changes.

0.4 QQQ & TQQQ

0.4.1 Acquire & Plot Data (QQQ)

First, let's get the data for QQQ. If we already have the desired data, we can load it from a local file. Otherwise, we can download it from Yahoo Finance using the `yf_pull_data` function.

[4]:
```python
yf_pull_data(
    base_directory=DATA_DIR,
    ticker="QQQ",
    adjusted=False,
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    excel_export=True,
    pickle_export=True,
    output_confirmation=False,
)

qqq = load_data(
    base_directory=DATA_DIR,
    ticker="QQQ",
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    timeframe="Daily",
    file_format="pickle",
)

# Rename columns to "QQQ_Close", etc.
qqq = qqq.rename(columns={
    "Adj Close": "QQQ_Adj_Close",
    "Close": "QQQ_Close",
    "High": "QQQ_High",
    "Low": "QQQ_Low",
    "Open": "QQQ_Open",
    "Volume": "QQQ_Volume"
})
```

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

This gives us:

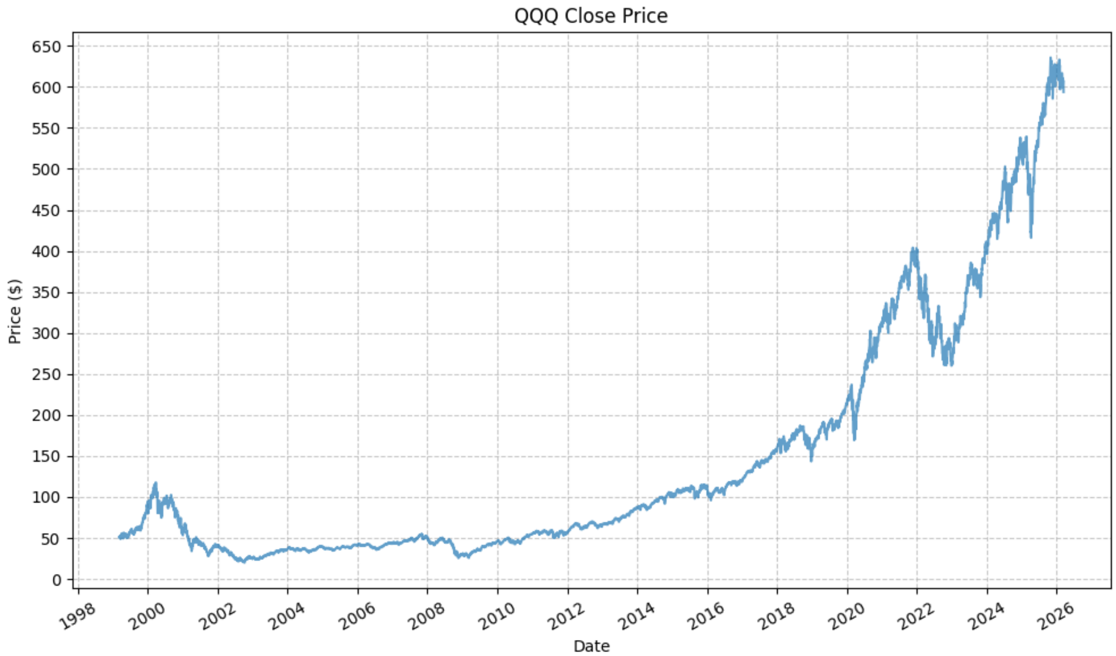
[5]:
```python
display(qqq)
```

```
            QQQ_Adj_Close  QQQ_Close   QQQ_High    QQQ_Low   QQQ_Open  \
Date
1999-03-10      43.128670  51.062500  51.156250  50.281250  51.125000
1999-03-11      43.339809  51.312500  51.734375  50.312500  51.437500
1999-03-12      42.284039  50.062500  51.156250  49.656250  51.125000
1999-03-15      43.498177  51.500000  51.562500  49.906250  50.437500
```

```
1999-03-16      43.867699   51.937500   52.156250   51.156250   51.718750
…                   …           …           …           …           …
2026-03-09     607.760010  607.760010  609.270020  591.330017  594.229980
2026-03-10     607.770020  607.770020  613.289978  605.419983  607.780029
2026-03-11     607.690002  607.690002  612.429993  605.030029  608.950012
2026-03-12     597.260010  597.260010  604.140015  597.049988  602.760010
2026-03-13     593.719971  593.719971  603.599976  592.570007  599.729980

            QQQ_Volume
Date
1999-03-10     5232000
1999-03-11     9688600
1999-03-12     8743600
1999-03-15     6369000
1999-03-16     4905800
…                  …
2026-03-09    93068200
2026-03-10    64078900
2026-03-11    60114800
2026-03-12    71836600
2026-03-13    62986500

[6795 rows x 6 columns]
```

And the plot of the timseries of ajdusted close prices:

[6]:
```python
plot_timeseries(
    df=qqq,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["QQQ_Close"],
    title="QQQ Close Price",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=2,
    x_tick_rotation=30,
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=False,
    export_plot=False,
    plot_file_name=None,
)
```



0.4.2 Acquire & Plot Data (TQQQ)

Next, TQQQ:

[7]:
```python
yf_pull_data(
    base_directory=DATA_DIR,
    ticker="TQQQ",
    adjusted=False,
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    excel_export=True,
    pickle_export=True,
    output_confirmation=False,
)

tqqq = load_data(
    base_directory=DATA_DIR,
    ticker="TQQQ",
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    timeframe="Daily",
    file_format="pickle",
)

# Rename columns to "TQQQ_Close", etc.
tqqq = tqqq.rename(columns={
```

```
    "Adj Close": "TQQQ_Adj_Close",
    "Close": "TQQQ_Close",
    "High": "TQQQ_High",
    "Low": "TQQQ_Low",
    "Open": "TQQQ_Open",
    "Volume": "TQQQ_Volume"
})
```

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

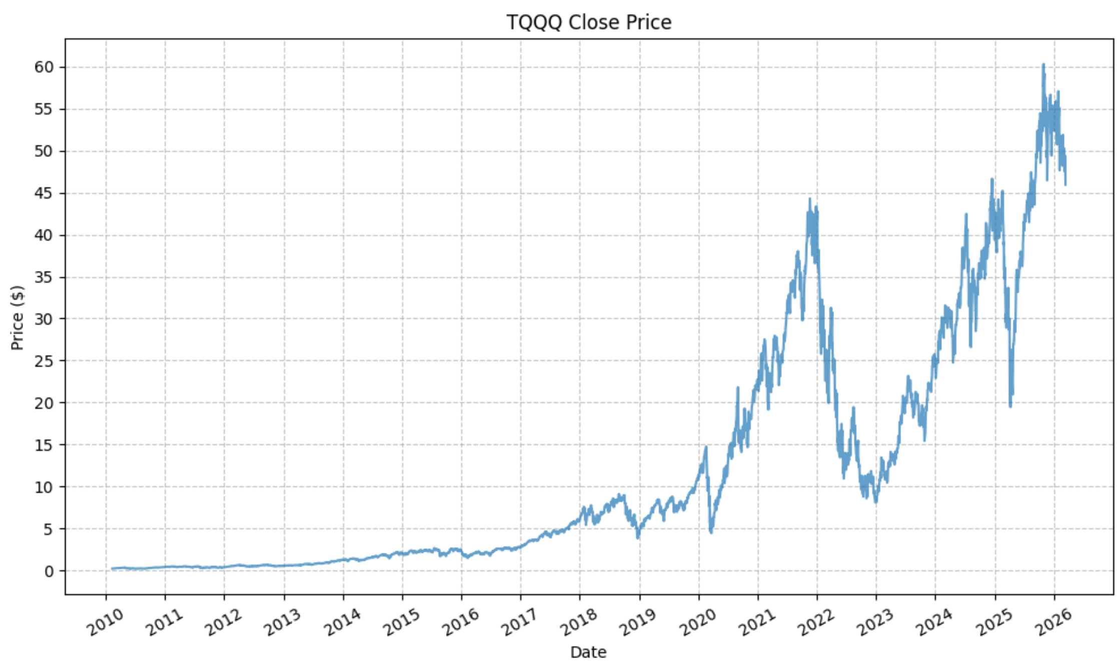
This gives us:

[8]:
```
display(tqqq)
```

```
            TQQQ_Adj_Close  TQQQ_Close  TQQQ_High   TQQQ_Low  TQQQ_Open  \
Date
2010-02-11        0.206396    0.216276   0.217448   0.202786   0.203438
2010-02-12        0.207241    0.217161   0.219036   0.209167   0.210391
2010-02-16        0.215268    0.225573   0.226094   0.218776   0.222266
2010-02-17        0.218921    0.229401   0.229453   0.225156   0.228594
2010-02-18        0.223072    0.233750   0.235130   0.227786   0.229167
…                      …          …          …         …         …
2026-03-09       49.389999   49.389999  49.770000  45.500000  46.189999
2026-03-10       49.400002   49.400002  50.740002  48.830002  49.410000
2026-03-11       49.349998   49.349998  50.520000  48.730000  49.680000
2026-03-12       46.830002   46.830002  48.490002  46.750000  48.150002
2026-03-13       45.930000   45.930000  48.250000  45.669998  47.349998

            TQQQ_Volume
Date
2010-02-11      6912000
2010-02-12     17203200
2010-02-16     19238400
2010-02-17     38361600
2010-02-18     77721600
…                 …
2026-03-09    159005500
2026-03-10    115057200
2026-03-11     91104300
2026-03-12    130823900
2026-03-13    141444100

[4046 rows x 6 columns]
```

And the plot of the timseries of ajdusted close prices:

[9]:
```
plot_timeseries(
    df=tqqq,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["TQQQ_Close"],
    title="TQQQ Close Price",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=1,
    x_tick_rotation=30,
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=False,
    export_plot=False,
    plot_file_name=None,
)
```



Looking at the close prices doesn't give us a true picture of the magnitude of the difference in returns due to the leverage. In order to see that, we need to look at the cumulative returns and the drawdowns.

Calculate & Plot Cumulative Returns, Rolling Returns, and Drawdowns (QQQ & TQQQ)

Next, we will calculate the cumulative returns, rolling returns, and drawdowns. This involves aligning the data to start with the inception of TQQQ. For this excercise, we will not extrapolate the data for QQQ back to 1999, but rather just align the data from the inception of TQQQ in 2010.

[10]:
```python
etfs = ["QQQ", "TQQQ"]

# Merge dataframes and drop rows with missing values
qqq_tqqq_aligned = tqqq.merge(qqq, left_index=True, right_index=True, how='left')
qqq_tqqq_aligned = qqq_tqqq_aligned.dropna()

# Calculate cumulative returns
for etf in etfs:
    qqq_tqqq_aligned[f"{etf}_Return"] = qqq_tqqq_aligned[f"{etf}_Close"].pct_change()
    qqq_tqqq_aligned[f"{etf}_Cumulative_Return"] = (1 + qqq_tqqq_aligned[f"{etf}_Return"]).cumprod() - 1
    qqq_tqqq_aligned[f"{etf}_Cumulative_Return_Plus_One"] = 1 + qqq_tqqq_aligned[f"{etf}_Cumulative_Return"]
    qqq_tqqq_aligned[f"{etf}_Rolling_Max"] = qqq_tqqq_aligned[f"{etf}_Cumulative_Return_Plus_One"].cummax()
    qqq_tqqq_aligned[f"{etf}_Drawdown"] = qqq_tqqq_aligned[f"{etf}_Cumulative_Return_Plus_One"] / qqq_tqqq_aligned[f"{etf}_Rolling_Max"] - 1
    qqq_tqqq_aligned.drop(columns=[f"{etf}_Cumulative_Return_Plus_One", f"{etf}_Rolling_Max"], inplace=True)

# Define rolling windows in trading days
rolling_windows = {
    '1d': 1,       # 1 day
    '1w': 5,       # 1 week (5 trading days)
    '1m': 21,      # 1 month (~21 trading days)
    '3m': 63,      # 3 months (~63 trading days)
    '6m': 126,     # 6 months (~126 trading days)
    '1y': 252,     # 1 year (~252 trading days)
    '2y': 504,     # 2 years (~504 trading days)
    '3y': 756,     # 3 years (~756 trading days)
    '4y': 1008,    # 4 years (~1008 trading days)
    '5y': 1260,    # 5 years (~1260 trading days)
}

# Calculate rolling returns for each ETF and each window
for etf in etfs:
    for period_name, window in rolling_windows.items():
        qqq_tqqq_aligned[f"{etf}_Rolling_Return_{period_name}"] = (
            qqq_tqqq_aligned[f"{etf}_Close"].pct_change(periods=window)
```

```
    )
```

[11]:
```python
display(qqq_tqqq_aligned)
```

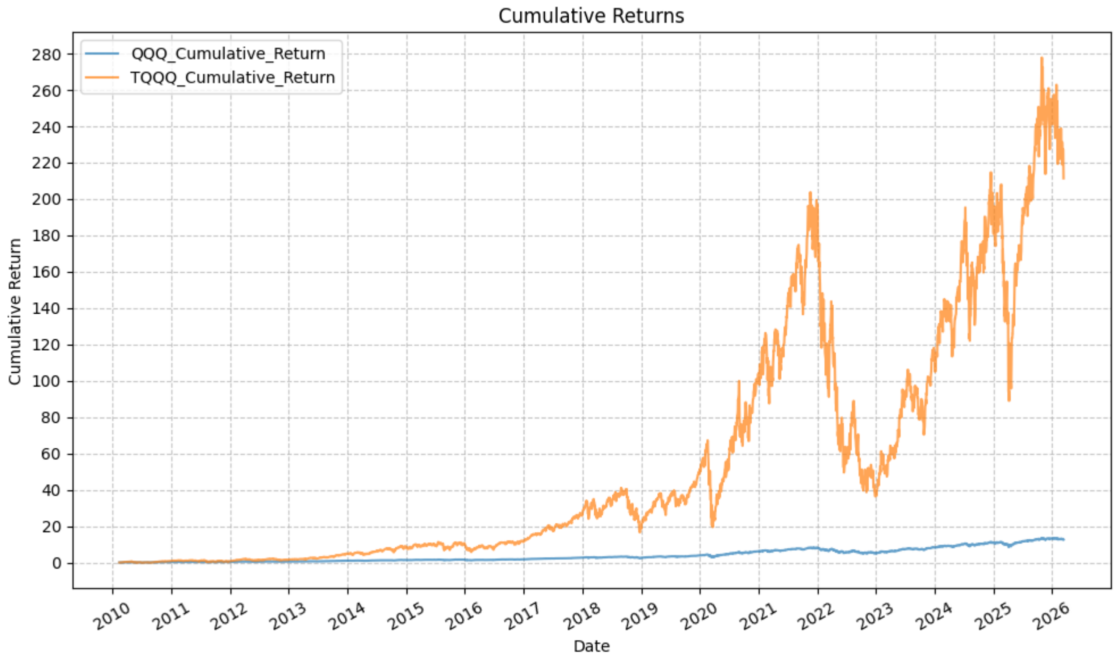
```
            TQQQ_Adj_Close  TQQQ_Close  TQQQ_High   TQQQ_Low  TQQQ_Open  \
Date
2010-02-11        0.206396    0.216276   0.217448   0.202786   0.203438
2010-02-12        0.207241    0.217161   0.219036   0.209167   0.210391
2010-02-16        0.215268    0.225573   0.226094   0.218776   0.222266
2010-02-17        0.218921    0.229401   0.229453   0.225156   0.228594
2010-02-18        0.223072    0.233750   0.235130   0.227786   0.229167
…                      …          …         …         …         …
2026-03-09       49.389999   49.389999  49.770000  45.500000  46.189999
2026-03-10       49.400002   49.400002  50.740002  48.830002  49.410000
2026-03-11       49.349998   49.349998  50.520000  48.730000  49.680000
2026-03-12       46.830002   46.830002  48.490002  46.750000  48.150002
2026-03-13       45.930000   45.930000  48.250000  45.669998  47.349998

            TQQQ_Volume  QQQ_Adj_Close   QQQ_Close    QQQ_High     QQQ_Low  \
Date
2010-02-11      6912000      37.951683   43.669998   43.790001   42.759998
2010-02-12     17203200      38.029903   43.759998   43.880001   43.160000
2010-02-16     19238400      38.516556   44.320000   44.349998   43.849998
2010-02-17     38361600      38.733829   44.570000   44.570000   44.259998
2010-02-18     77721600      38.977173   44.849998   44.930000   44.450001
…                   …             …           …          …          …
2026-03-09    159005500     607.760010  607.760010  609.270020  591.330017
2026-03-10    115057200     607.770020  607.770020  613.289978  605.419983
2026-03-11     91104300     607.690002  607.690002  612.429993  605.030029
2026-03-12    130823900     597.260010  597.260010  604.140015  597.049988
2026-03-13    141444100     593.719971  593.719971  603.599976  592.570007

            …  TQQQ_Rolling_Return_1d  TQQQ_Rolling_Return_1w  \
Date        …
2010-02-11  …                     NaN                     NaN
2010-02-12  …                0.004092                     NaN
2010-02-16  …                0.038736                     NaN
2010-02-17  …                0.016970                     NaN
2010-02-18  …                0.018958                     NaN
…          …                    …                      …
2026-03-09  …                0.038915               -0.006237
2026-03-10  …                0.000203                0.027027
2026-03-11  …               -0.001012               -0.018106
2026-03-12  …               -0.051064               -0.059639
2026-03-13  …               -0.019218               -0.033866

            TQQQ_Rolling_Return_1m  TQQQ_Rolling_Return_3m  \
Date
```

```
2010-02-11                  NaN                  NaN
2010-02-12                  NaN                  NaN
2010-02-16                  NaN                  NaN
2010-02-17                  NaN                  NaN
2010-02-18                  NaN                  NaN
…                             …                    …
2026-03-09             0.036734            -0.110250
2026-03-10            -0.023522            -0.120214
2026-03-11            -0.046193            -0.115591
2026-03-12            -0.082125            -0.163899
2026-03-13            -0.106420            -0.189232

            TQQQ_Rolling_Return_6m  TQQQ_Rolling_Return_1y  \
Date
2010-02-11                     NaN                     NaN
2010-02-12                     NaN                     NaN
2010-02-16                     NaN                     NaN
2010-02-17                     NaN                     NaN
2010-02-18                     NaN                     NaN
…                                …                       …
2026-03-09                0.075800                0.495760
2026-03-10                0.060883                0.465658
2026-03-11                0.051230                0.650226
2026-03-12               -0.003511                0.584504
2026-03-13               -0.038820                0.502699

            TQQQ_Rolling_Return_2y  TQQQ_Rolling_Return_3y  \
Date
2010-02-11                     NaN                     NaN
2010-02-12                     NaN                     NaN
2010-02-16                     NaN                     NaN
2010-02-17                     NaN                     NaN
2010-02-18                     NaN                     NaN
…                                …                       …
2026-03-09                0.583520                3.467662
2026-03-10                0.673442                3.211424
2026-03-11                0.641443                3.189304
2026-03-12                0.491164                3.129630
2026-03-13                0.529471                2.995650

            TQQQ_Rolling_Return_4y  TQQQ_Rolling_Return_5y
Date
2010-02-11                     NaN                     NaN
2010-02-12                     NaN                     NaN
2010-02-16                     NaN                     NaN
2010-02-17                     NaN                     NaN
2010-02-18                     NaN                     NaN
…                                …                       …
```

```
2026-03-09              0.974021            1.139253
2026-03-10              0.884417            1.342898
2026-03-11              0.964570            1.462268
2026-03-12              0.947598            1.236390
2026-03-13              1.150281            1.398433

[4046 rows x 38 columns]
```

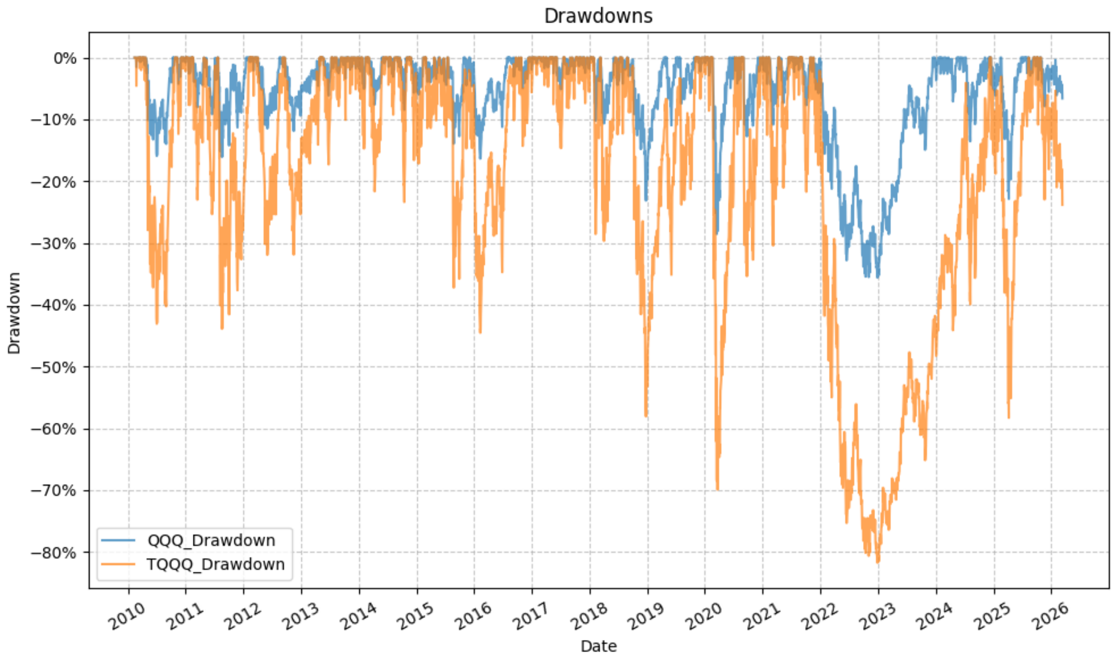
And now the plot for the cumulative returns:

[12]:
```
plot_timeseries(
    df=qqq_tqqq_aligned,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["QQQ_Cumulative_Return", "TQQQ_Cumulative_Return"],
    title="Cumulative Returns",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=1,
    x_tick_rotation=30,
    y_label="Cumulative Return",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



And the drawdown plot:

[13]:
```
plot_timeseries(
    df=qqq_tqqq_aligned,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["QQQ_Drawdown", "TQQQ_Drawdown"],
    title="Drawdowns",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=1,
    x_tick_rotation=30,
    y_label="Drawdown",
    y_format="Percentage",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



Here is where we truly see the volatility of TQQQ relative to QQQ. In the past 5 years, TQQQ has had drawdowns of 50%, 60%, 70%, and 80%. While it has recovered to make new highs (with the exception of the current ~10% drawdown), very few investors can endure those drawdowns and continue to hold their position. At the same time, we can see from the plot that a ~35% drawdown in QQQ equated to a ~80% drawdown in TQQQ, which is not in fact, 3x. So this tells us that there is dispersion in the long term returns relative to the short term returns between the non-leveraged QQQ and 3x leveraged TQQQ. This idea is well documented in the financial literature as "volatility decay" or "volatility drag". But, and this is the question we are trying to answer, how significant is this effect over various time horizons?

0.4.3 Summary Statistics (QQQ & TQQQ)

Looking at the summary statistics further confirms our intuitions about the volatility and drawdowns.

[14]:
```
qqq_sum_stats = summary_stats(
    fund_list=["QQQ"],
    df=qqq_tqqq_aligned[["QQQ_Return"]],
    period="Daily",
    use_calendar_days=False,
    excel_export=False,
    pickle_export=False,
    output_confirmation=False,
)

tqqq_sum_stats = summary_stats(
```

```python
    fund_list=["TQQQ"],
    df=qqq_tqqq_aligned[["TQQQ_Return"]],
    period="Daily",
    use_calendar_days=False,
    excel_export=False,
    pickle_export=False,
    output_confirmation=False,
)

sum_stats = pd.concat([qqq_sum_stats, tqqq_sum_stats])

display(sum_stats)
```

```
             Annual Mean Return (Arithmetic)  Annualized Volatility  \
QQQ_Return                          0.183897               0.206040
TQQQ_Return                         0.521888               0.609705

             Annualized Sharpe Ratio  CAGR (Geometric)  Daily Max Return  \
QQQ_Return                  0.892532          0.176501          0.120031
TQQQ_Return                 0.855969          0.396175          0.352442

            Daily Max Return (Date)  Daily Min Return Daily Min Return (Date)  \
QQQ_Return               2025-04-09         -0.119788              2020-03-16
TQQQ_Return              2025-04-09         -0.344652              2020-03-16

             Max Drawdown       Peak     Trough Recovery Date  \
QQQ_Return      -0.356172 2021-11-19 2022-12-28    2023-12-15
TQQQ_Return     -0.817545 2021-11-19 2022-12-28    2024-12-11

             Days to Recovery  MAR Ratio
QQQ_Return                352    0.49555
TQQQ_Return               714    0.48459
```

Note that these statistics are being run on the partially-adjusted close prices, which are not the true returns, but they do give us a good picture of the relative volatility and drawdowns of the two ETFs. The mean return for TQQQ is much higher than that of QQQ, but the standard deviation is also much higher, which is consistent with the idea of leverage amplifying both the upside and the downside. The maximum drawdown for TQQQ is also much higher than that of QQQ, which again confirms our observations from the drawdown plot.

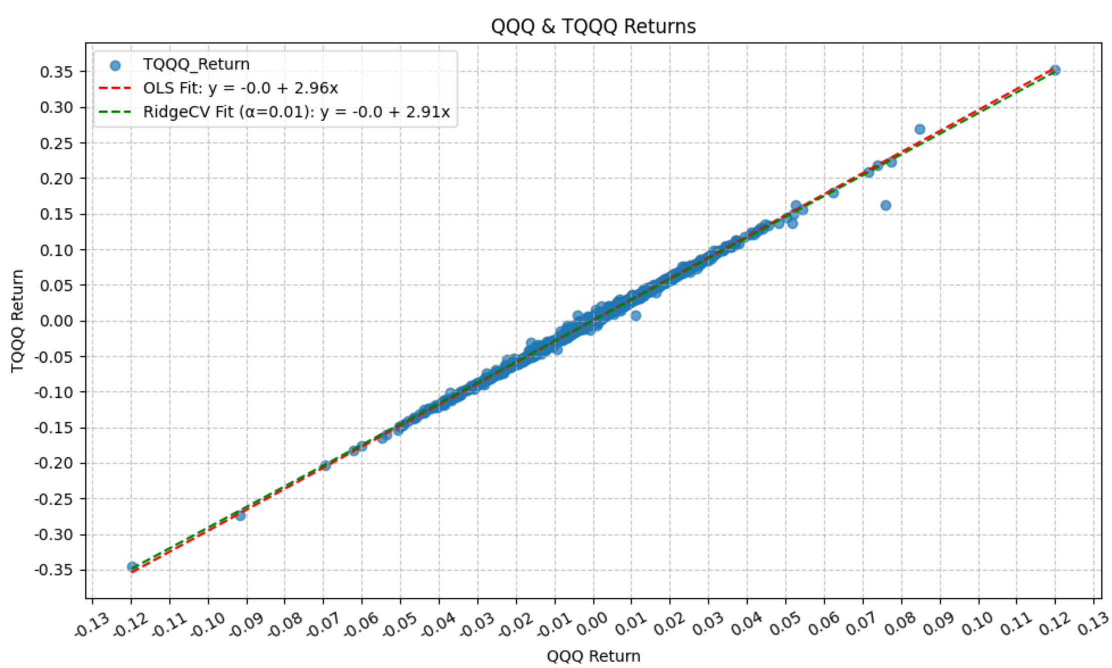
Also note that the daily maximum return for both funds occured during "Liberation Day" and the daily minimum return for both funds occured early on during COVID.

0.4.4 Plot Returns & Verify Beta (QQQ & TQQQ)

Before we look at the rolling returns, let us first verify that the daily returns for TQQQ are in fact ~3x those of QQQ.

[15]:

```python
plot_scatter(
    df=qqq_tqqq_aligned,
    x_plot_column="QQQ_Return",
    y_plot_columns=["TQQQ_Return"],
    title="QQQ & TQQQ Returns",
    x_label="QQQ Return",
    x_format="Decimal",
    x_format_decimal_places=2,
    x_tick_spacing="Auto",
    x_tick_rotation=30,
    y_label="TQQQ Return",
    y_format="Decimal",
    y_format_decimal_places=2,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=True,
    OLS_column="TQQQ_Return",
    plot_Ridge_regression_line=False,
    Ridge_column=None,
    plot_RidgeCV_regression_line=True,
    RidgeCV_column="TQQQ_Return",
    regression_constant=True,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



[16]:
```python
model = run_linear_regression(
    df=qqq_tqqq_aligned,
    x_plot_column="QQQ_Return",
    y_plot_column="TQQQ_Return",
    regression_model="OLS-statsmodels",
    regression_constant=True,
)

print(model.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:            TQQQ_Return   R-squared:                       0.997
Model:                            OLS   Adj. R-squared:                  0.997
Method:                 Least Squares   F-statistic:                 1.492e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):               0.00
Time:                        14:26:00   Log-Likelihood:                 19405.
No. Observations:                4045   AIC:                        -3.881e+04
Df Residuals:                    4043   BIC:                        -3.879e+04
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const      -8.554e-05   3.15e-05     -2.720      0.007      -0.000   -2.39e-05
QQQ_Return     2.9552      0.002   1221.329      0.000       2.950       2.960
==============================================================================
Omnibus:                     5272.508   Durbin-Watson:                   2.566
Prob(Omnibus):                  0.000   Jarque-Bera (JB):          9175082.049
Skew:                          -6.344   Prob(JB):                         0.00
Kurtosis:                     235.974   Cond. No.                         77.1
==============================================================================

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

Visually, this plot makes sense and we can see that there is a strong clustering of points, but we double check with the regression, regressing the TQQQ daily return (y) on the QQQ daily return (X).

Given the above result, with a coefficient of 2.96 and an R^2 of 0.997, we can say that TQQQ does in fact return ~3x QQQ. We would also intuitively expect the coefficient to be 0, which it is nearly.

Interestingly, the coefficient varies between OLS and Ridge cross-validation, and both are less than 3.

0.4.5 Extrapolate Data (QQQ & TQQQ)

We will now extrapolate the returns of QQQ to backfill the data from the inception of QQQ in 1999 to the inception of TQQQ in 2010. For this, we'll use the coefficient of 2.96 that we found in the regression results above.

[17]:
```python
# Set leverage multiplier based on regression coefficient
LEVERAGE_MULTIPLIER = model.params[1]

# Merge dataframes and extrapolate return values for QQQ back to 1999 using the
 ↪leverage multiplier
qqq_tqqq_extrap = qqq[["QQQ_Close"]].merge(tqqq[["TQQQ_Close"]],
 ↪left_index=True, right_index=True, how='left')

etfs = ["QQQ", "TQQQ"]

# Calculate cumulative returns
for etf in etfs:
    qqq_tqqq_extrap[f"{etf}_Return"] = qqq_tqqq_extrap[f"{etf}_Close"].
 ↪pct_change()

# Extrapolate TQQQ returns for missing values
qqq_tqqq_extrap["TQQQ_Return"] = qqq_tqqq_extrap["TQQQ_Return"].
 ↪fillna(LEVERAGE_MULTIPLIER * qqq_tqqq_extrap["QQQ_Return"])

# Find the first valid TQQQ_Close index and value
first_valid_idx = qqq_tqqq_extrap['TQQQ_Close'].first_valid_index()
print(first_valid_idx)
first_valid_price = qqq_tqqq_extrap.loc[first_valid_idx, 'TQQQ_Close']
print(first_valid_price)
```

```
2010-02-11 00:00:00
0.21627600491046906
```

Before we extrapolate, let's first look at the data we have for QQQ and TQQQ around the inception of TQQQ in 2010:

[18]:
```python
# Check values around the first valid index
print(qqq_tqqq_extrap.loc["2010-02-08":"2010-02-13"])
```

```
            QQQ_Close  TQQQ_Close  QQQ_Return  TQQQ_Return
Date
2010-02-08  42.669998         NaN   -0.007213    -0.021315
2010-02-09  43.110001         NaN    0.010312     0.030473
2010-02-10  43.020000         NaN   -0.002088    -0.006169
2010-02-11  43.669998    0.216276    0.015109     0.044650
2010-02-12  43.759998    0.217161    0.002061     0.004092
```

Now, backfill the data for the TQQQ close price:

[19]:
```python
# Iterate through the dataframe backwards
for i in range(qqq_tqqq_extrap.index.get_loc(first_valid_idx) - 1, -1, -1):

    # The return that led to the price the next day
    current_return = qqq_tqqq_extrap.iloc[i + 1]['TQQQ_Return']

    # Get the next day's price
    next_price = qqq_tqqq_extrap.iloc[i + 1]['TQQQ_Close']

    # Price_{t} = Price_{t+1} / (1 + Return_{t})
    qqq_tqqq_extrap.loc[qqq_tqqq_extrap.index[i], 'TQQQ_Close'] = next_price /␣
 ↪(1 + current_return)
```

Finally, confirm the values are correct:

[20]:
```python
# Confirm values around the first valid index after extrapolation
print(qqq_tqqq_extrap.loc["2010-02-08":"2010-02-13"])
```

```
             QQQ_Close  TQQQ_Close  QQQ_Return  TQQQ_Return
Date
2010-02-08   42.669998    0.202157   -0.007213    -0.021315
2010-02-09   43.110001    0.208317    0.010312     0.030473
2010-02-10   43.020000    0.207032   -0.002088    -0.006169
2010-02-11   43.669998    0.216276    0.015109     0.044650
2010-02-12   43.759998    0.217161    0.002061     0.004092
```

And the complete DataFrame with the extrapolated values:

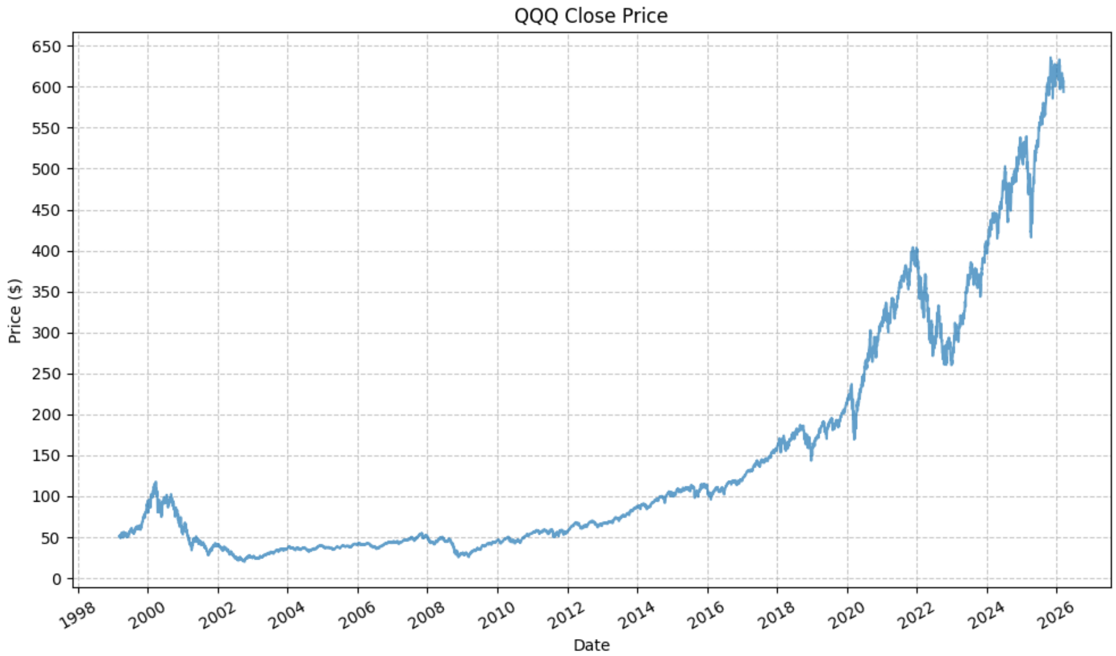
[21]:
```python
display(qqq_tqqq_extrap)
```

```
              QQQ_Close  TQQQ_Close  QQQ_Return  TQQQ_Return
Date
1999-03-10    51.062500   13.813139         NaN          NaN
1999-03-11    51.312500   14.012991    0.004896     0.014468
1999-03-12    50.062500   13.004208   -0.024361    -0.071989
1999-03-15    51.500000   14.107675    0.028714     0.084855
1999-03-16    51.937500   14.461841    0.008495     0.025104
…                     …           …           …            …
2026-03-09   607.760010   49.389999    0.013356     0.038915
2026-03-10   607.770020   49.400002    0.000016     0.000203
2026-03-11   607.690002   49.349998   -0.000132    -0.001012
2026-03-12   597.260010   46.830002   -0.017163    -0.051064
2026-03-13   593.719971   45.930000   -0.005927    -0.019218

[6795 rows x 4 columns]
```

After the extrapolation, we now have the following plots for the prices, cumulative returns, and drawdowns:

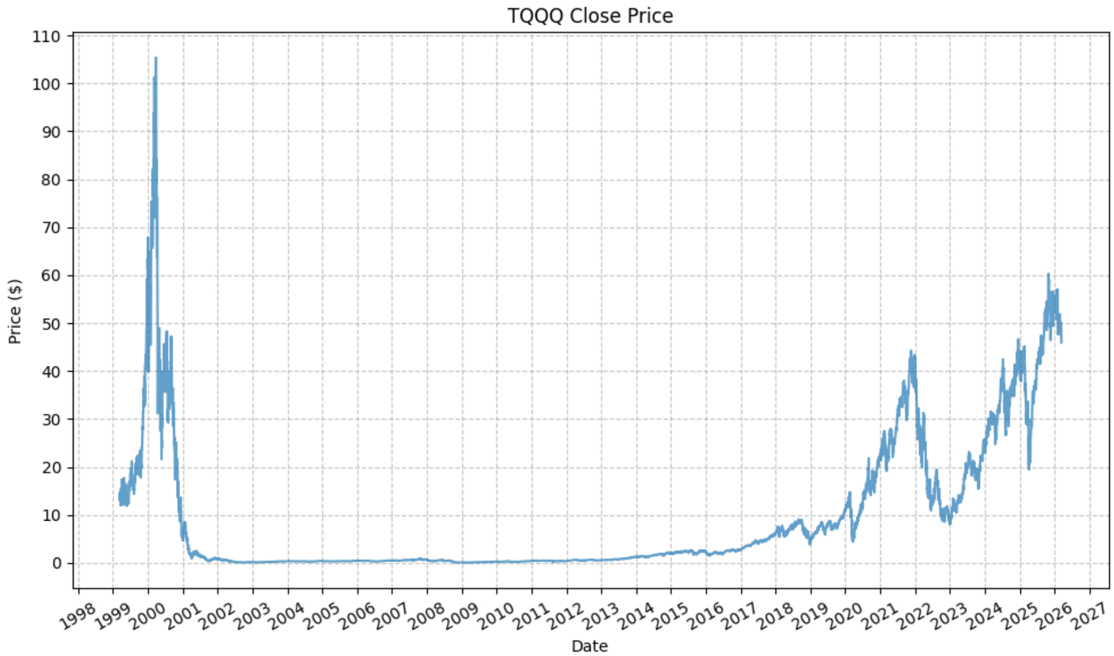
[22]:
```python
etfs = ["QQQ", "TQQQ"]

# Calculate cumulative returns
for etf in etfs:
    qqq_tqqq_extrap[f"{etf}_Return"] = qqq_tqqq_extrap[f"{etf}_Close"].
    ↪pct_change()
    qqq_tqqq_extrap[f"{etf}_Cumulative_Return"] = (1 +␣
    ↪qqq_tqqq_extrap[f"{etf}_Return"]).cumprod() - 1
    qqq_tqqq_extrap[f"{etf}_Cumulative_Return_Plus_One"] = 1 +␣
    ↪qqq_tqqq_extrap[f"{etf}_Cumulative_Return"]
    qqq_tqqq_extrap[f"{etf}_Rolling_Max"] =␣
    ↪qqq_tqqq_extrap[f"{etf}_Cumulative_Return_Plus_One"].cummax()
    qqq_tqqq_extrap[f"{etf}_Drawdown"] =␣
    ↪qqq_tqqq_extrap[f"{etf}_Cumulative_Return_Plus_One"] /␣
    ↪qqq_tqqq_extrap[f"{etf}_Rolling_Max"] - 1
    qqq_tqqq_extrap.drop(columns=[f"{etf}_Cumulative_Return_Plus_One",␣
    ↪f"{etf}_Rolling_Max"], inplace=True)
```

[23]:
```python
plot_timeseries(
    df=qqq_tqqq_extrap,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["QQQ_Close"],
    title="QQQ Close Price",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=2,
    x_tick_rotation=30,
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=False,
    export_plot=False,
    plot_file_name=None,
)
```



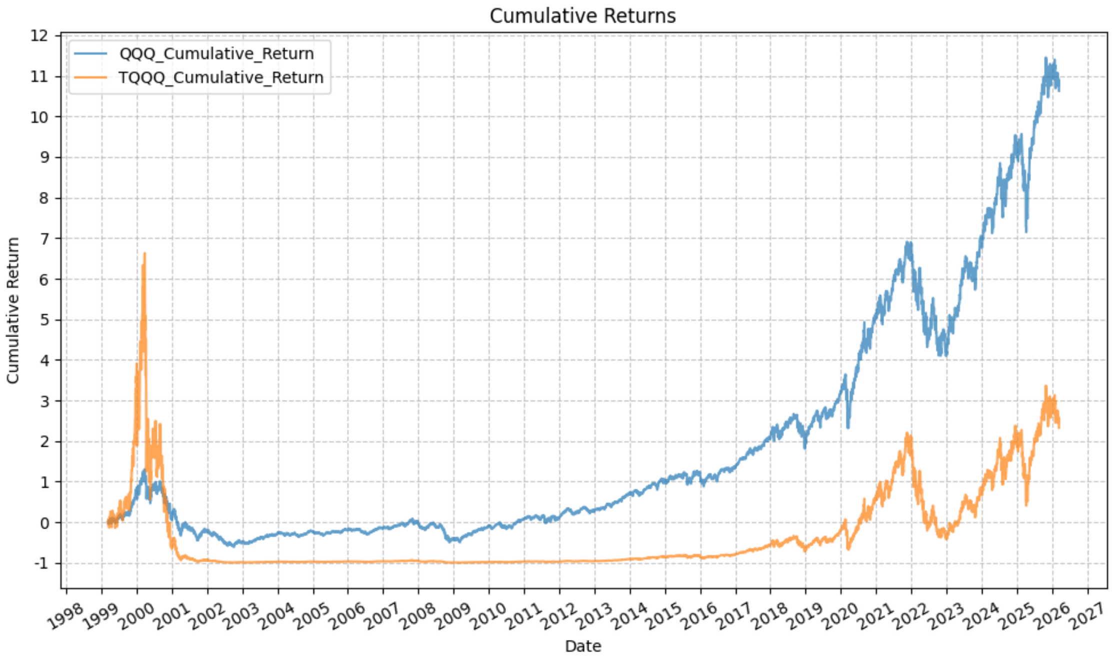
[24]:

```
plot_timeseries(
    df=qqq_tqqq_extrap,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["TQQQ_Close"],
    title="TQQQ Close Price",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=1,
    x_tick_rotation=30,
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=False,
    export_plot=False,
    plot_file_name=None,
)
```



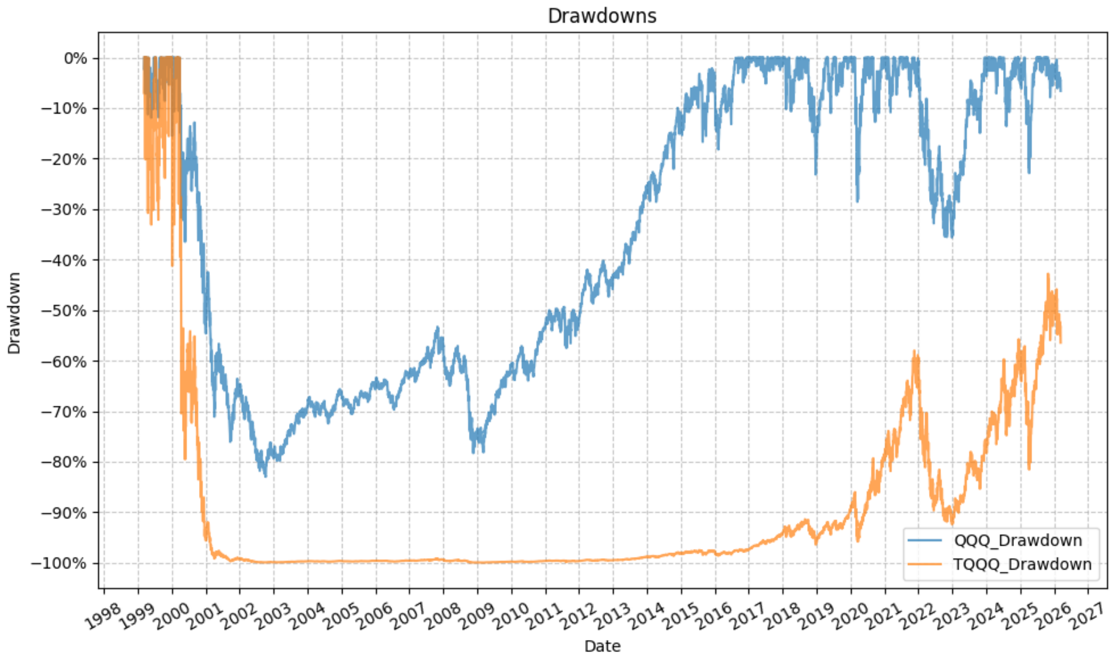
[25]:

```
plot_timeseries(
    df=qqq_tqqq_extrap,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["QQQ_Cumulative_Return", "TQQQ_Cumulative_Return"],
    title="Cumulative Returns",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=1,
    x_tick_rotation=30,
    y_label="Cumulative Return",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



[26]:

```
plot_timeseries(
    df=qqq_tqqq_extrap,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["QQQ_Drawdown", "TQQQ_Drawdown"],
    title="Drawdowns",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=1,
    x_tick_rotation=30,
    y_label="Drawdown",
    y_format="Percentage",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



Some quick comments before we look at rolling returns. The drawdown is nearly 100%… which represents nearly a total loss of capital for any allocation to the extrap-TQQQ. Furthermore, as we walk forward through time (2002, 2003, … etc.), there is really no reason to believe that the returns would ever recover (even partially). So, while we can look at the rolling returns and see how they compare to the 3x return of QQQ, we should keep in mind that the drawdown is so severe that it would be very difficult for any investor to hold through it.

0.4.6 Plot Rolling Returns (QQQ & TQQQ)

Next, we will consider the following:

- Histogram and scatter plots of the rolling returns of QQQ and TQQQ
- Regressions to establish a "leverage factor" for the rolling returns
- The deviation from a 3x return for each time period

For this set of regressions, we will also allow the constant. First, we need the rolling returns for various time periods:

[27]:
```
# Define rolling windows in trading days
rolling_windows = {
    '1d': 1,       # 1 day
    '1w': 5,       # 1 week (5 trading days)
    '1m': 21,      # 1 month (~21 trading days)
    '3m': 63,      # 3 months (~63 trading days)
    '6m': 126,     # 6 months (~126 trading days)
    '1y': 252,     # 1 year (~252 trading days)
    '2y': 504,     # 2 years (~504 trading days)
```

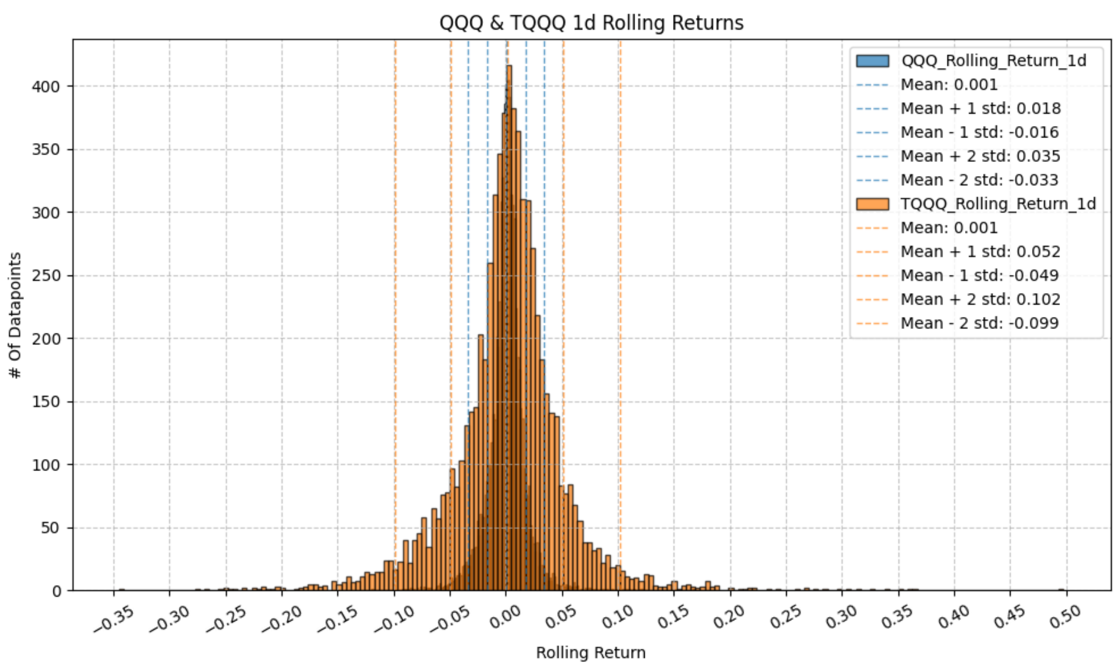
```
    '3y': 756,    # 3 years (~756 trading days)
    '4y': 1008,   # 4 years (~1008 trading days)
    '5y': 1260,   # 5 years (~1260 trading days)
}

# Calculate rolling returns for each ETF and each window
for etf in etfs:
    for period_name, window in rolling_windows.items():
        qqq_tqqq_extrap[f"{etf}_Rolling_Return_{period_name}"] = (
            qqq_tqqq_extrap[f"{etf}_Close"].pct_change(periods=window)
        )
```

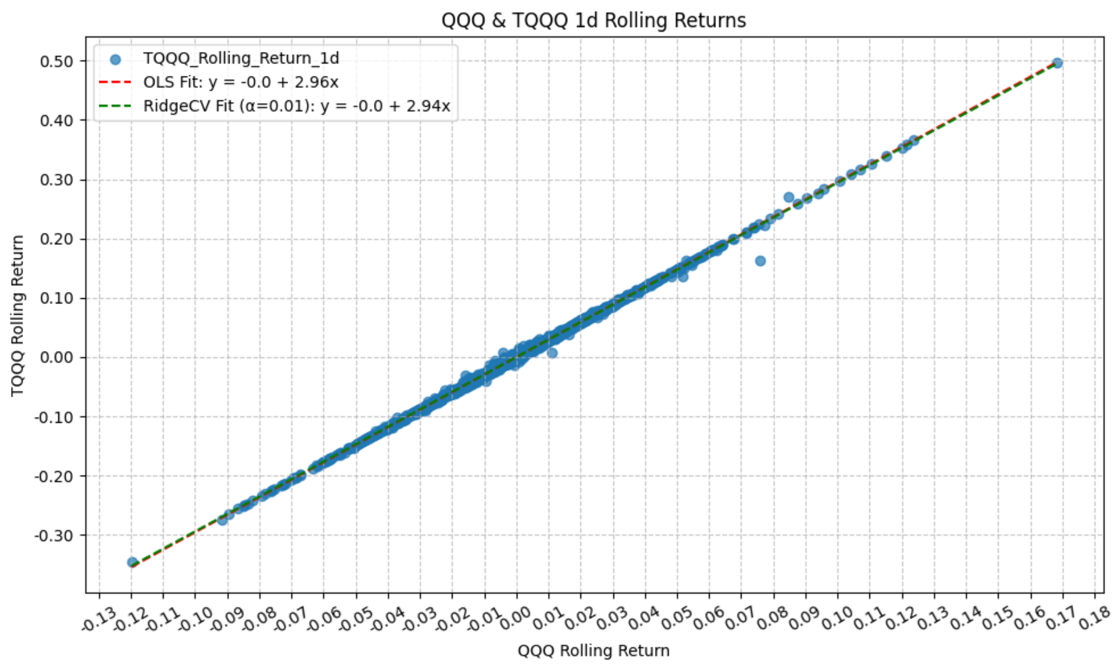
This gives us the following series of histograms, scatter plots, and regression model results:

[28]:
```
# Create a dataframe to hold rolling returns stats
rolling_returns_stats = pd.DataFrame()

for period_name, window in rolling_windows.items():
    plot_histogram(
        df=qqq_tqqq_extrap,
        plot_columns=[f"QQQ_Rolling_Return_{period_name}",␣
 ↪f"TQQQ_Rolling_Return_{period_name}"],
        title=f"QQQ & TQQQ {period_name} Rolling Returns",
        x_label="Rolling Return",
        x_tick_spacing="Auto",
        x_tick_rotation=30,
        y_label="# Of Datapoints",
        y_tick_spacing="Auto",
        y_tick_rotation=0,
        grid=True,
        legend=True,
        export_plot=False,
        plot_file_name=None,
    )

    plot_scatter(
        df=qqq_tqqq_extrap,
        x_plot_column=f"QQQ_Rolling_Return_{period_name}",
        y_plot_columns=[f"TQQQ_Rolling_Return_{period_name}"],
        title=f"QQQ & TQQQ {period_name} Rolling Returns",
        x_label="QQQ Rolling Return",
        x_format="Decimal",
        x_format_decimal_places=2,
        x_tick_spacing="Auto",
        x_tick_rotation=30,
        y_label="TQQQ Rolling Return",
        y_format="Decimal",
```

```
        y_format_decimal_places=2,
        y_tick_spacing="Auto",
        y_tick_rotation=0,
        plot_OLS_regression_line=True,
        OLS_column=f"TQQQ_Rolling_Return_{period_name}",
        plot_Ridge_regression_line=False,
        Ridge_column=None,
        plot_RidgeCV_regression_line=True,
        RidgeCV_column=f"TQQQ_Rolling_Return_{period_name}",
        regression_constant=True,
        grid=True,
        legend=True,
        export_plot=False,
        plot_file_name=None,
    )

    # Run OLS regression with statsmodels
    model = run_linear_regression(
        df=qqq_tqqq_extrap,
        x_plot_column=f"QQQ_Rolling_Return_{period_name}",
        y_plot_column=f"TQQQ_Rolling_Return_{period_name}",
        regression_model="OLS-statsmodels",
        regression_constant=True,
    )
    print(model.summary())

    # Add the regression results to the rolling returns stats dataframe
    intercept = model.params[0]
    intercept_pvalue = model.pvalues[0]   # p-value for Intercept
    slope = model.params[1]
    slope_pvalue = model.pvalues[1]       # p-value for QQQ_Return
    r_squared = model.rsquared

    # Calc skew
    return_ratio = qqq_tqqq_extrap[f'TQQQ_Rolling_Return_{period_name}'] /␣
↪qqq_tqqq_extrap[f'QQQ_Rolling_Return_{period_name}']
    skew = return_ratio.skew()

    # Calc conditional symmetry
    up_markets =␣
↪qqq_tqqq_extrap[qqq_tqqq_extrap[f'QQQ_Rolling_Return_{period_name}'] > 0]
    down_markets =␣
↪qqq_tqqq_extrap[qqq_tqqq_extrap[f'QQQ_Rolling_Return_{period_name}'] <= 0]

    avg_beta_up = (up_markets[f'TQQQ_Rolling_Return_{period_name}'] /␣
↪up_markets[f'QQQ_Rolling_Return_{period_name}']).mean()
```

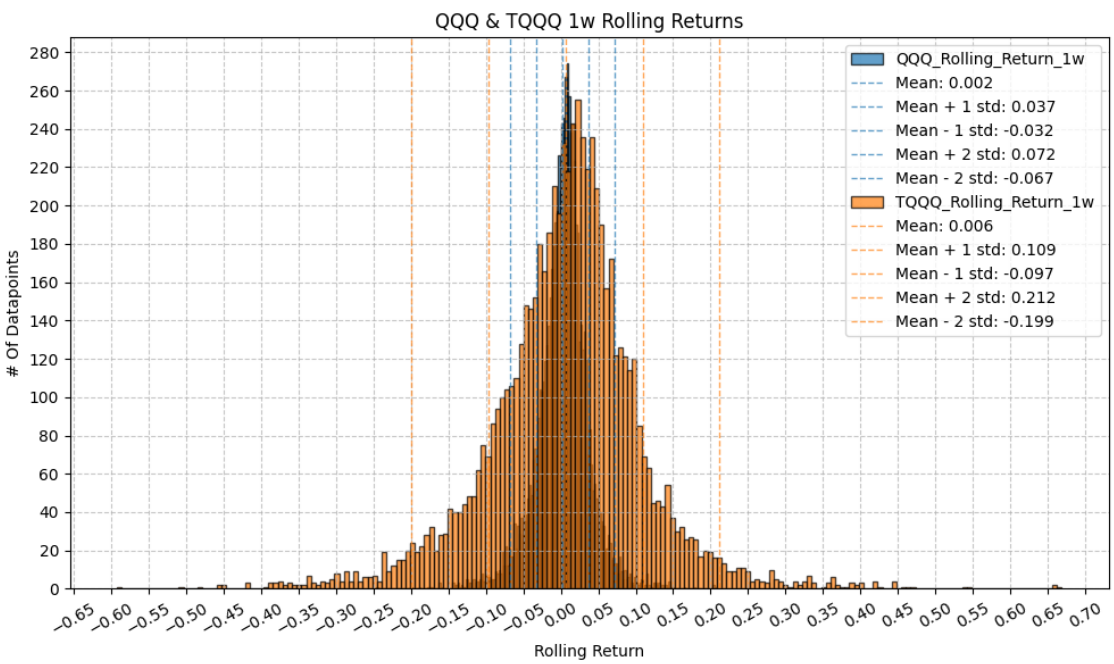
```
    avg_beta_down = (down_markets[f'TQQQ_Rolling_Return_{period_name}'] /␣
↪down_markets[f'QQQ_Rolling_Return_{period_name}']).mean()

    asymmetry = avg_beta_up - avg_beta_down

    rolling_returns_slope_int = pd.DataFrame({
        "Period": period_name,
        "Intercept": [intercept],
        # "Intercept_PValue": [intercept_pvalue],
        "Slope": [slope],
        # "Slope_PValue": [slope_pvalue],
        "R_Squared": [r_squared],
        "Skew": [skew],
        "Average Upside Beta": [avg_beta_up],
        "Average Downside Beta": [avg_beta_down],
        "Asymmetry": [asymmetry]
    })

    rolling_returns_stats = pd.concat([rolling_returns_stats,␣
↪rolling_returns_slope_int])
```

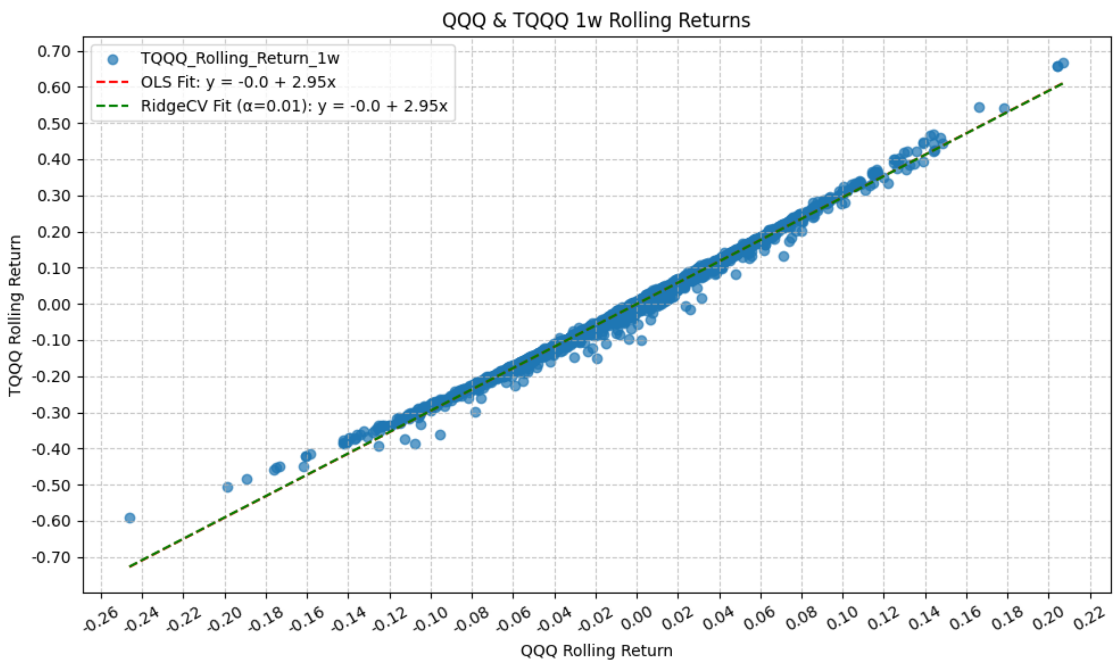





```
                            OLS Regression Results
================================================================================
==
Dep. Variable:     TQQQ_Rolling_Return_1d   R-squared:
0.999
Model:                                OLS   Adj. R-squared:
0.999
Method:                     Least Squares   F-statistic:
7.215e+06
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:03   Log-Likelihood:
34352.
No. Observations:                    6794   AIC:
-6.870e+04
Df Residuals:                        6792   BIC:
-6.869e+04
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
=========
                            coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                 -5.091e-05   1.87e-05     -2.721      0.007   -8.76e-05
```

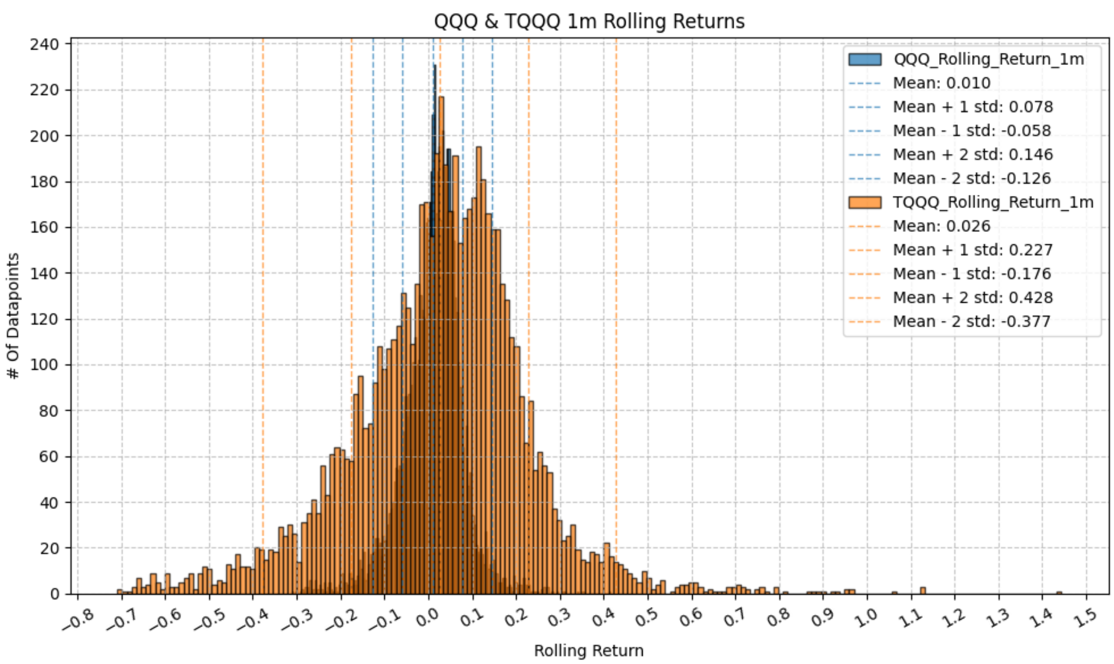
```
-1.42e-05
QQQ_Rolling_Return_1d     2.9551      0.001   2686.049      0.000       2.953
2.957
==============================================================================
Omnibus:                    10188.882   Durbin-Watson:                   2.565
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         43894224.936
Skew:                          -8.279   Prob(JB):                         0.00
Kurtosis:                     396.425   Cond. No.                         58.8
==============================================================================

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

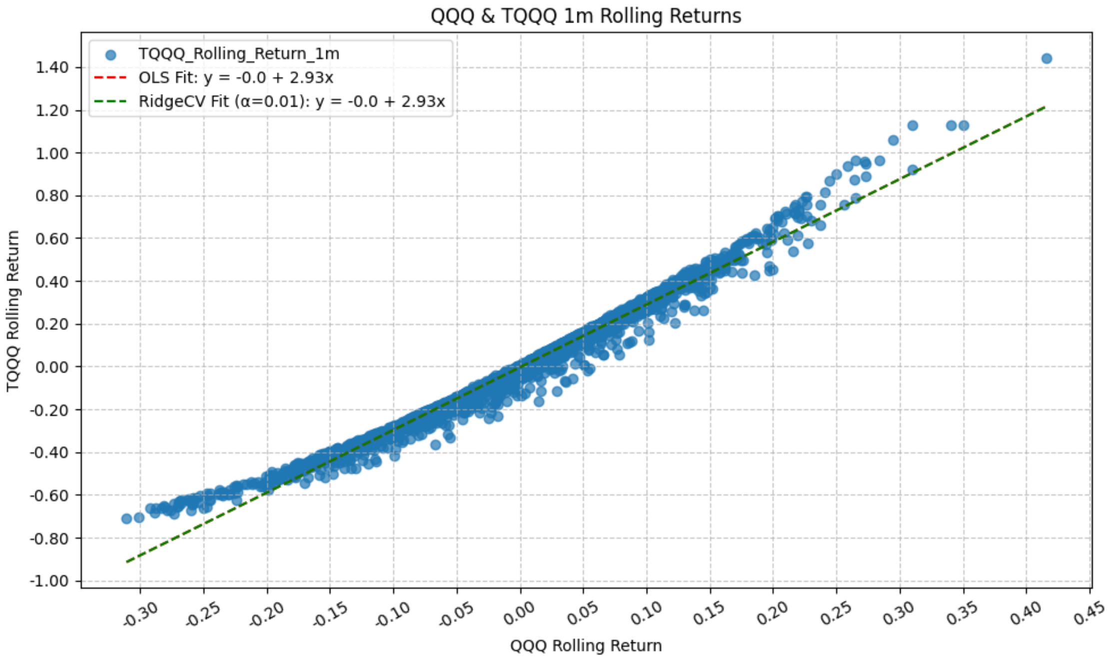





```
                            OLS Regression Results
================================================================================
==
Dep. Variable:     TQQQ_Rolling_Return_1w   R-squared:
0.994
Model:                                OLS   Adj. R-squared:
0.994
Method:                     Least Squares   F-statistic:
1.116e+06
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:04   Log-Likelihood:
23152.
No. Observations:                    6790   AIC:
-4.630e+04
Df Residuals:                        6788   BIC:
-4.629e+04
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
=========
                            coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                    -0.0008   9.73e-05     -8.330      0.000      -0.001
```

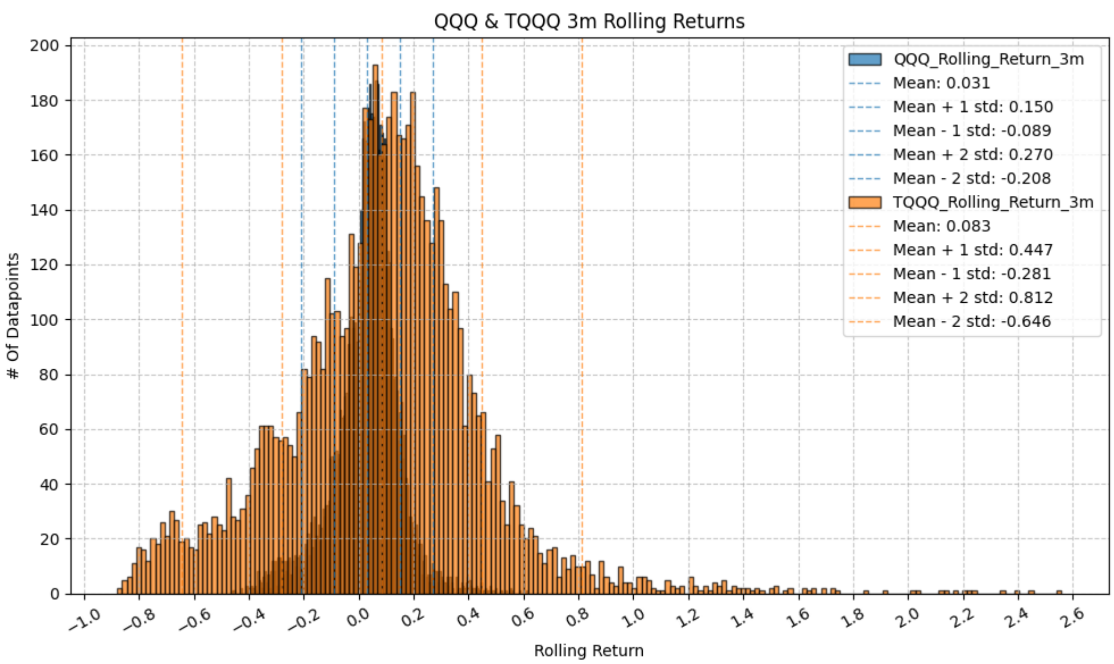
```
-0.001
QQQ_Rolling_Return_1w      2.9524       0.003    1056.353      0.000       2.947
2.958
==============================================================================
Omnibus:                     2839.003   Durbin-Watson:                   0.932
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           563907.961
Skew:                          -0.863   Prob(JB):                         0.00
Kurtosis:                      47.612   Cond. No.                         28.8
==============================================================================

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

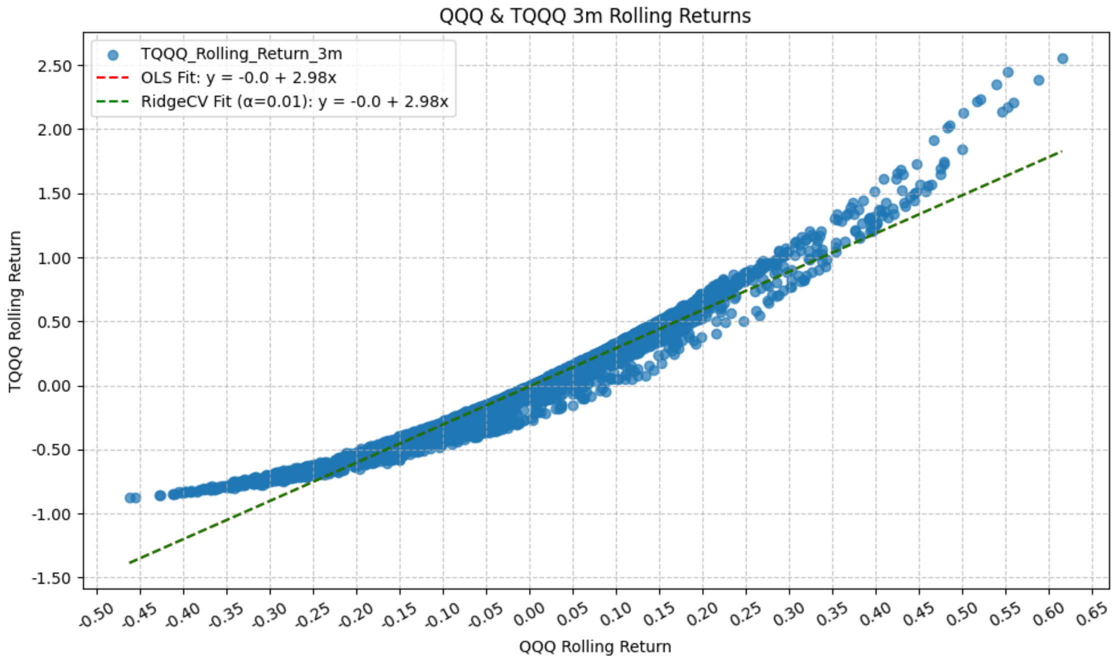





```
                            OLS Regression Results
================================================================================
==
Dep. Variable:      TQQQ_Rolling_Return_1m   R-squared:
0.982
Model:                                 OLS   Adj. R-squared:
0.982
Method:                      Least Squares   F-statistic:
3.695e+05
Date:                     Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                             14:26:05   Log-Likelihood:
14852.
No. Observations:                     6774   AIC:
-2.970e+04
Df Residuals:                         6772   BIC:
-2.969e+04
Df Model:                                1
Covariance Type:                 nonrobust
================================================================================
=========
                            coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                    -0.0037      0.000    -11.064      0.000      -0.004
```

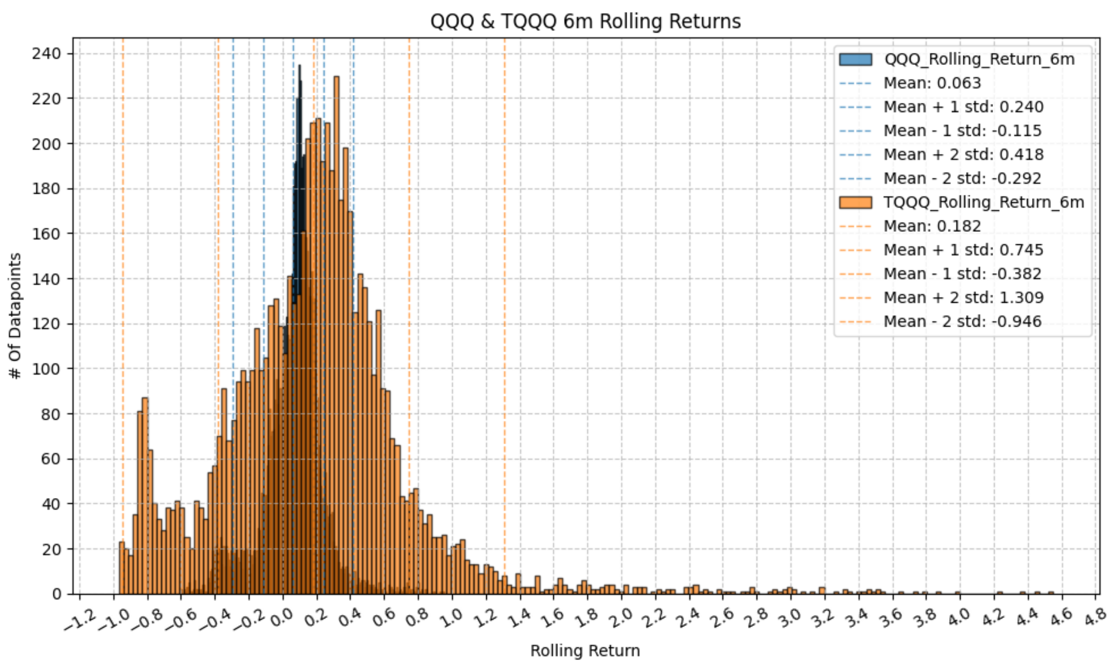
```
-0.003
QQQ_Rolling_Return_1m      2.9305      0.005     607.853      0.000       2.921
2.940
==============================================================================
Omnibus:                     1627.646   Durbin-Watson:                   0.296
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            69016.055
Skew:                           0.357   Prob(JB):                         0.00
Kurtosis:                      18.621   Cond. No.                         14.7
==============================================================================

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

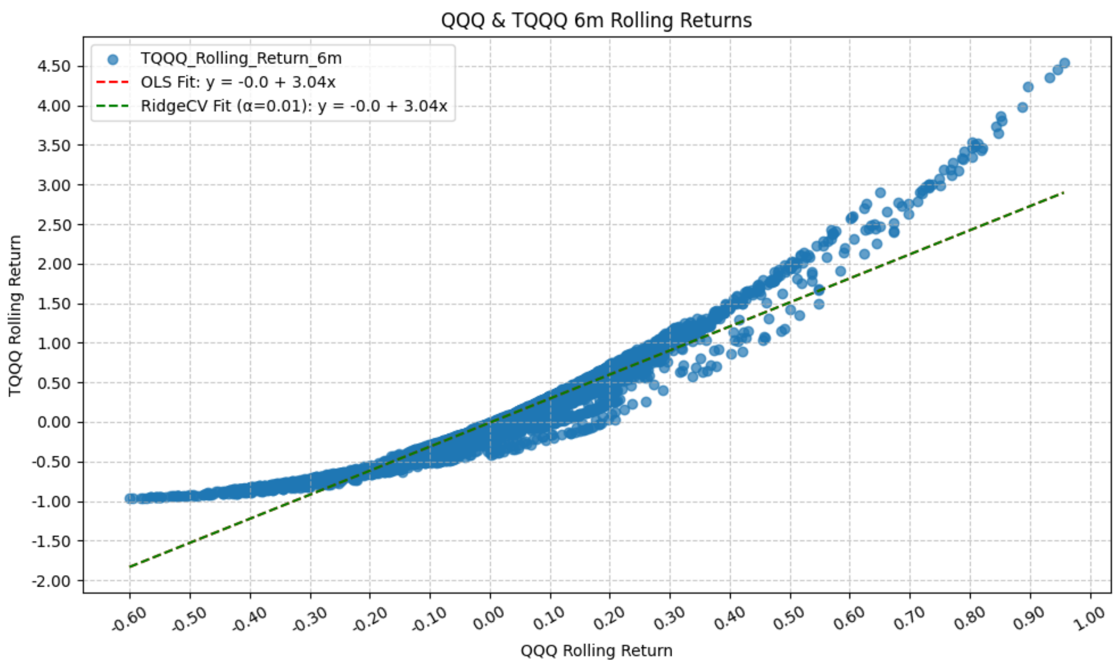





```
                            OLS Regression Results
================================================================================
==
Dep. Variable:     TQQQ_Rolling_Return_3m   R-squared:
0.958
Model:                                OLS   Adj. R-squared:
0.958
Method:                     Least Squares   F-statistic:
1.549e+05
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:06   Log-Likelihood:
7946.0
No. Observations:                    6732   AIC:
-1.589e+04
Df Residuals:                        6730   BIC:
-1.587e+04
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
=========
                            coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                    -0.0083      0.001     -8.841      0.000      -0.010
```

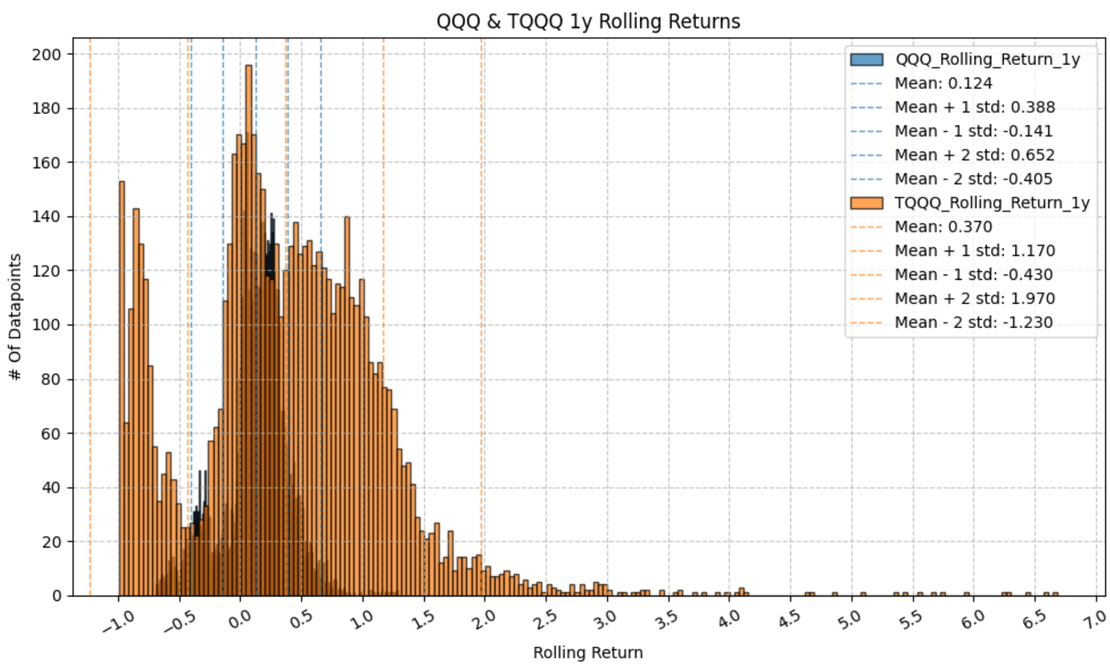
```
-0.006
QQQ_Rolling_Return_3m      2.9848       0.008     393.626       0.000       2.970
3.000
==============================================================================
Omnibus:                     3461.856   Durbin-Watson:                   0.105
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            79524.170
Skew:                           1.962   Prob(JB):                         0.00
Kurtosis:                      19.374   Cond. No.                         8.38
==============================================================================

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

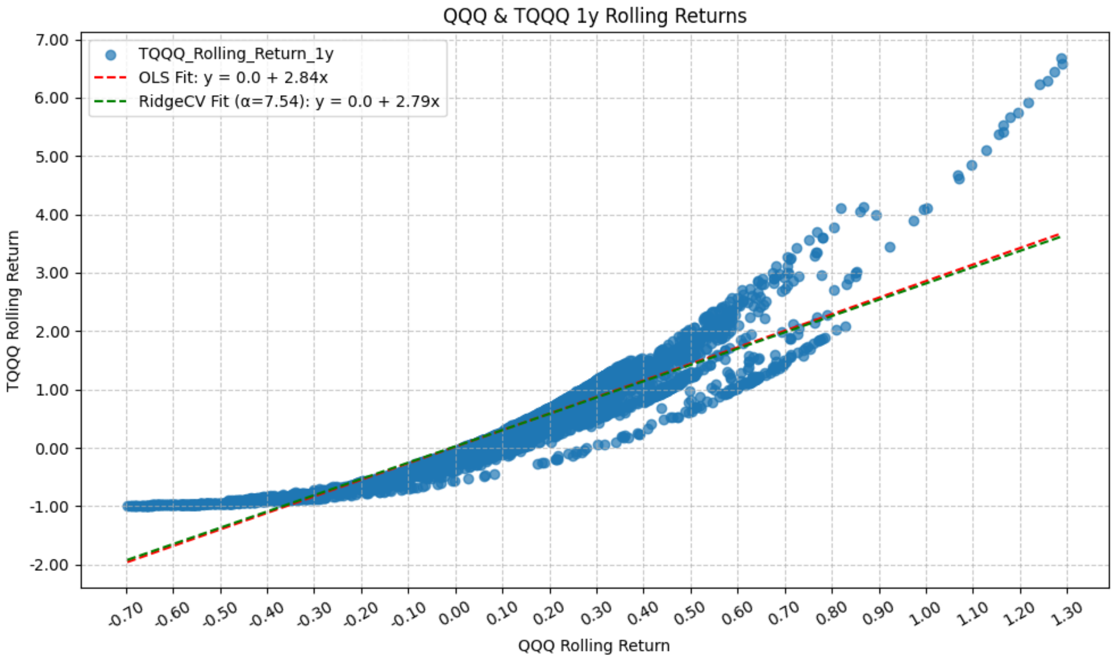





```
                            OLS Regression Results
================================================================================
==
Dep. Variable:     TQQQ_Rolling_Return_6m   R-squared:
0.916
Model:                                OLS   Adj. R-squared:
0.916
Method:                     Least Squares   F-statistic:
7.247e+04
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:08   Log-Likelihood:
2610.3
No. Observations:                    6669   AIC:
-5217.
Df Residuals:                        6667   BIC:
-5203.
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
=========
                            coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                    -0.0096      0.002     -4.515      0.000      -0.014
```

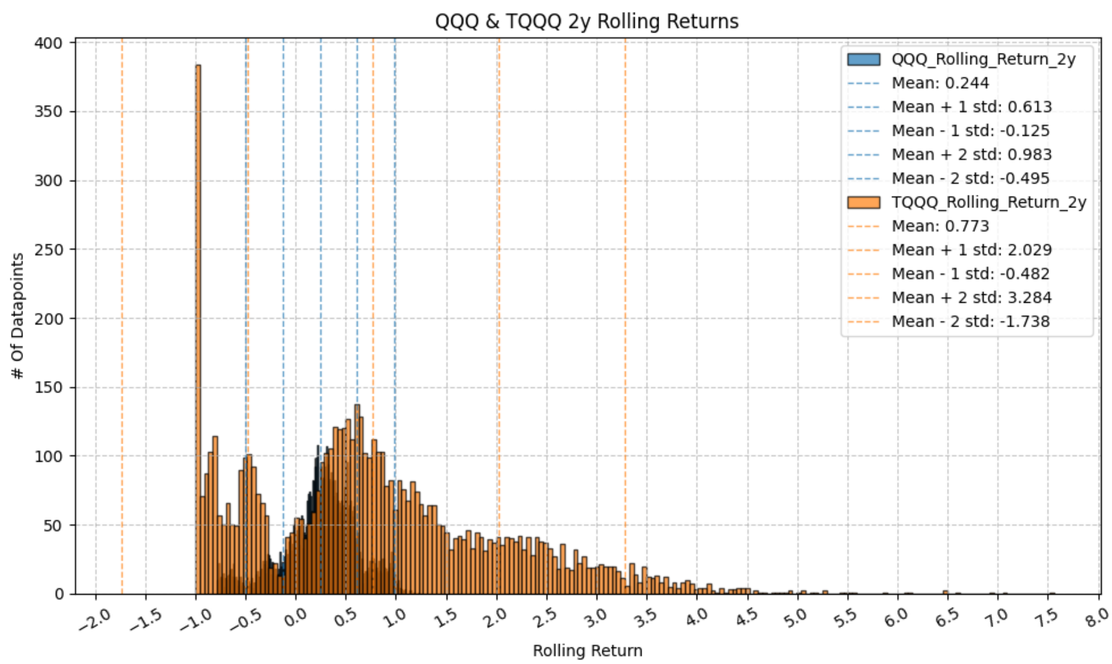
```
-0.005
QQQ_Rolling_Return_6m      3.0396      0.011    269.206      0.000       3.017
3.062
==============================================================================
Omnibus:                     3654.453   Durbin-Watson:                   0.056
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            60093.604
Skew:                           2.262   Prob(JB):                         0.00
Kurtosis:                      16.993   Cond. No.                         5.66
==============================================================================

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

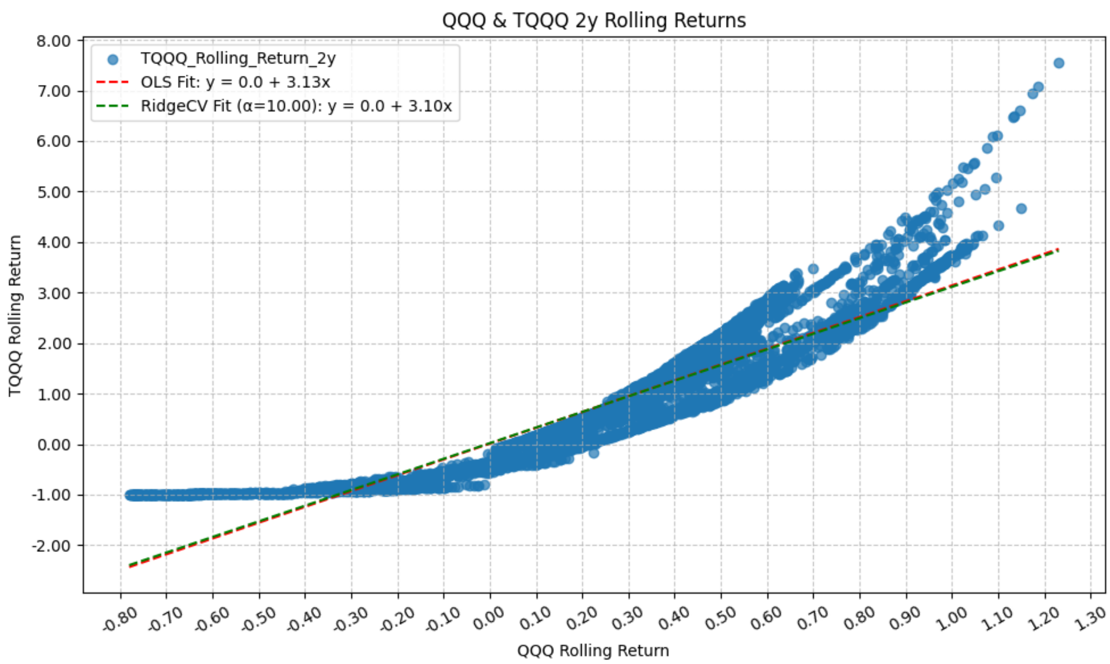





```
                            OLS Regression Results
==============================================================================
==
Dep. Variable:     TQQQ_Rolling_Return_1y   R-squared:
0.880
Model:                                OLS   Adj. R-squared:
0.880
Method:                     Least Squares   F-statistic:
4.785e+04
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:09   Log-Likelihood:
-892.54
No. Observations:                    6543   AIC:
1789.
Df Residuals:                        6541   BIC:
1803.
Df Model:                               1
Covariance Type:                nonrobust
==============================================================================
=========
                            coef    std err          t      P>|t|      [0.025
0.975]
------------------------------------------------------------------------------
---------
const                     0.0191      0.004      5.035      0.000       0.012
```

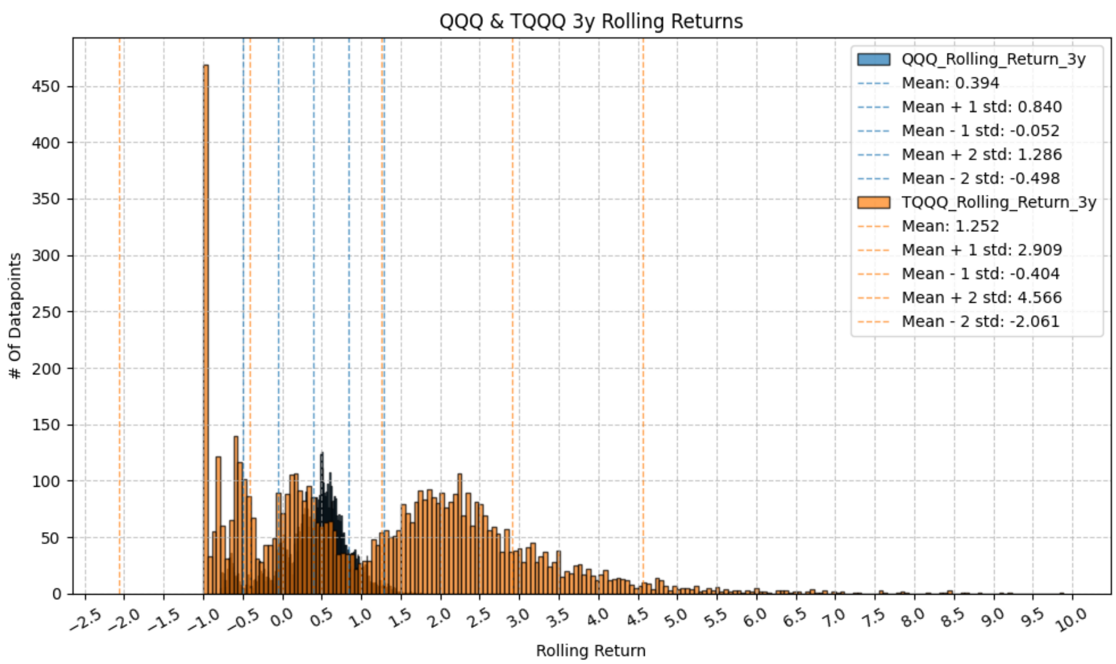
```
0.026
QQQ_Rolling_Return_1y     2.8375      0.013    218.746      0.000       2.812
2.863
==============================================================================
Omnibus:                     3492.635   Durbin-Watson:                   0.037
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            68111.624
Skew:                           2.122   Prob(JB):                         0.00
Kurtosis:                      18.226   Cond. No.                         3.84
==============================================================================

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

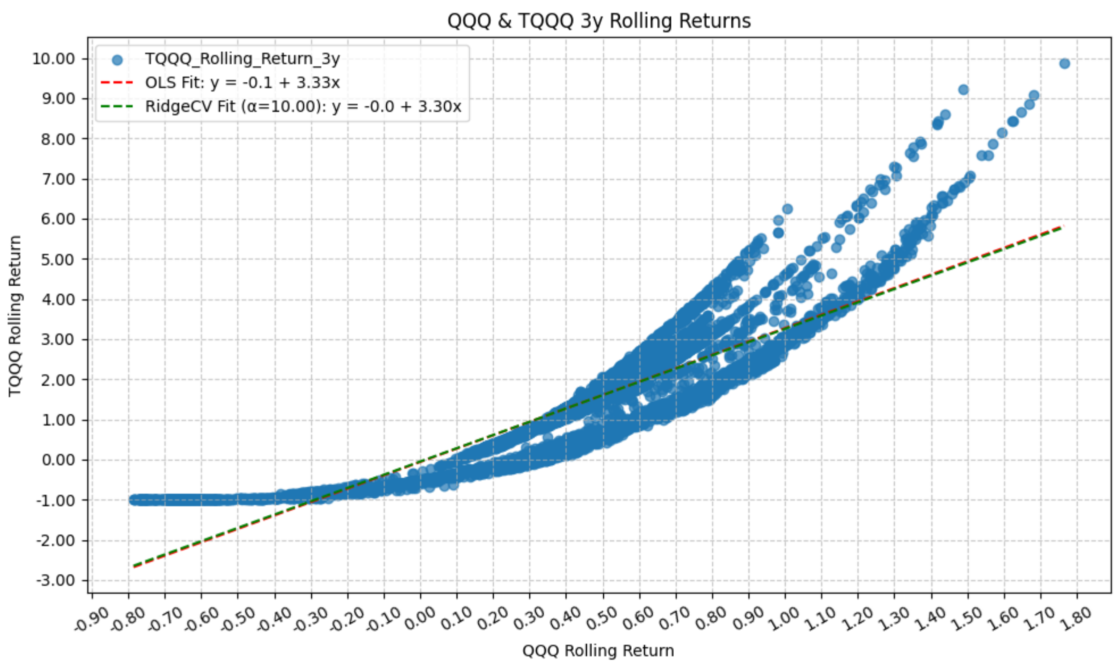





```
                            OLS Regression Results
================================================================================
==
Dep. Variable:     TQQQ_Rolling_Return_2y   R-squared:
0.849
Model:                                OLS   Adj. R-squared:
0.848
Method:                     Least Squares   F-statistic:
3.522e+04
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:10   Log-Likelihood:
-4421.2
No. Observations:                    6291   AIC:
8846.
Df Residuals:                        6289   BIC:
8860.
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
=========
                            coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                     0.0096      0.007      1.294      0.196      -0.005
```

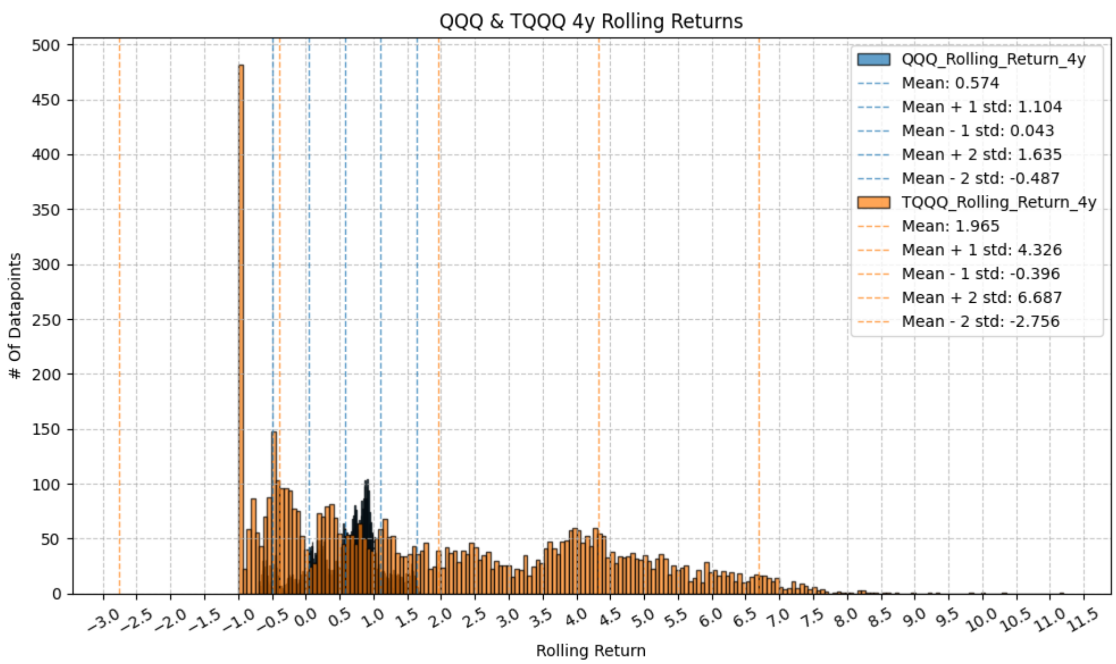
```
0.024
QQQ_Rolling_Return_2y     3.1314      0.017    187.680      0.000       3.099
3.164
==============================================================================
Omnibus:                     1595.143   Durbin-Watson:                   0.019
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4144.668
Skew:                           1.367   Prob(JB):                         0.00
Kurtosis:                       5.887   Cond. No.                         2.89
==============================================================================

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

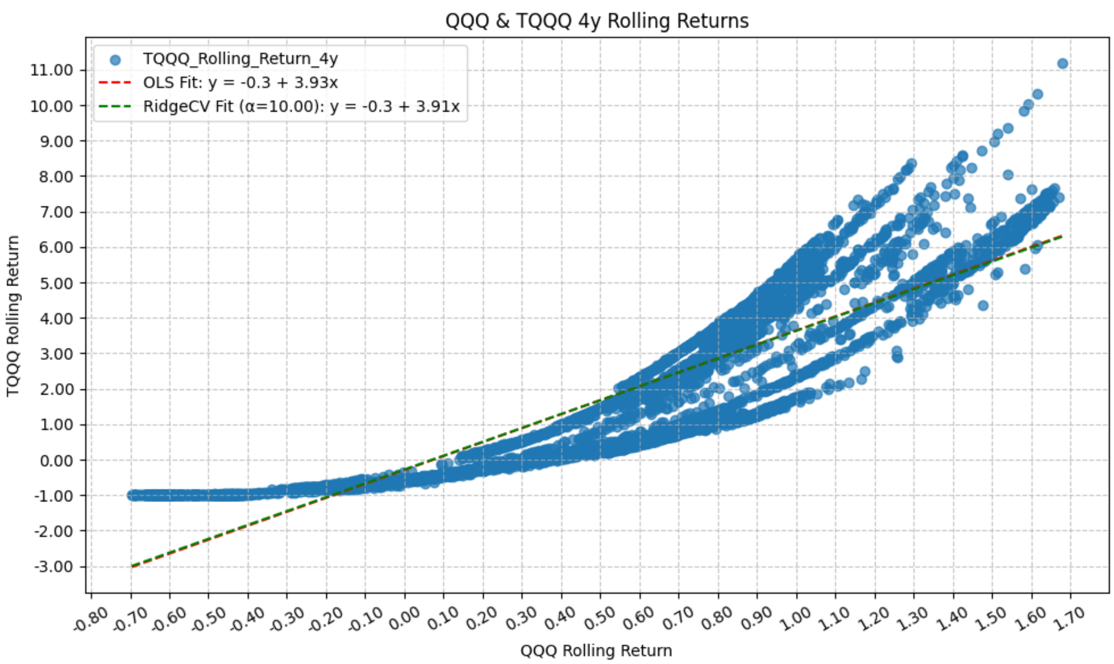





```
                            OLS Regression Results
==============================================================================
==
Dep. Variable:     TQQQ_Rolling_Return_3y   R-squared:
0.804
Model:                                OLS   Adj. R-squared:
0.804
Method:                     Least Squares   F-statistic:
2.481e+04
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:11   Log-Likelihood:
-6691.5
No. Observations:                    6039   AIC:
1.339e+04
Df Residuals:                        6037   BIC:
1.340e+04
Df Model:                               1
Covariance Type:                nonrobust
==============================================================================
=========
                            coef    std err          t      P>|t|      [0.025
0.975]
------------------------------------------------------------------------------
---------
const                    -0.0599      0.013     -4.763      0.000      -0.085
```

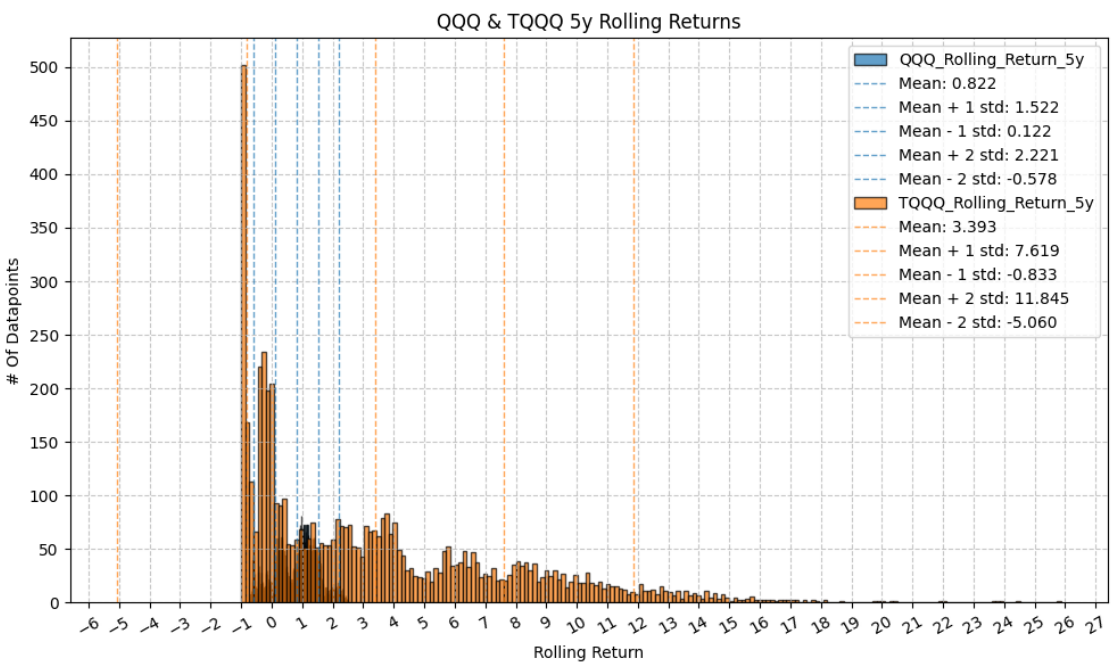
```
-0.035
QQQ_Rolling_Return_3y     3.3321      0.021    157.522      0.000       3.291
3.374
==============================================================================
Omnibus:                      855.515   Durbin-Watson:                   0.015
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1466.078
Skew:                           0.939   Prob(JB):                         0.00
Kurtosis:                       4.516   Cond. No.                         2.66
==============================================================================

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

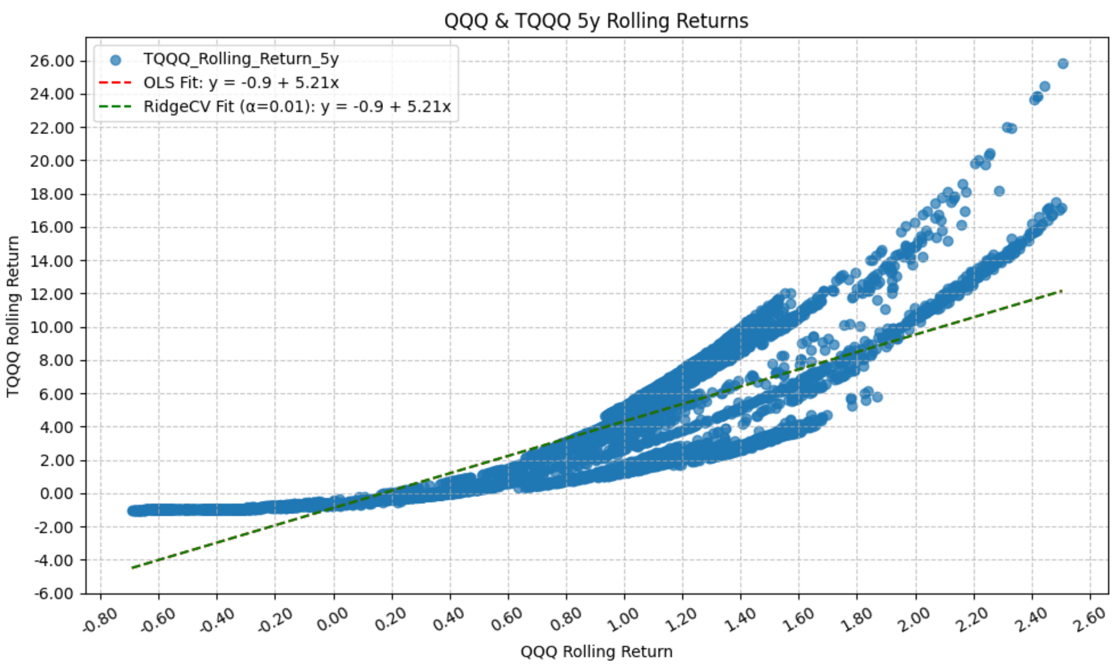





```
                            OLS Regression Results
================================================================================
==
Dep. Variable:     TQQQ_Rolling_Return_4y   R-squared:
0.781
Model:                                OLS   Adj. R-squared:
0.781
Method:                     Least Squares   F-statistic:
2.068e+04
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:12   Log-Likelihood:
-8782.4
No. Observations:                    5787   AIC:
1.757e+04
Df Residuals:                        5785   BIC:
1.758e+04
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
=========
                            coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                    -0.2922      0.021    -13.668      0.000      -0.334
```

```
-0.250
QQQ_Rolling_Return_4y     3.9343      0.027    143.797      0.000       3.881
3.988
==============================================================================
Omnibus:                      198.061   Durbin-Watson:                   0.010
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              103.519
Skew:                           0.140   Prob(JB):                     3.32e-23
Kurtosis:                       2.407   Cond. No.                         2.66
==============================================================================

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






```
                           OLS Regression Results
==============================================================================
==
Dep. Variable:      TQQQ_Rolling_Return_5y   R-squared:
0.743
Model:                                 OLS   Adj. R-squared:
0.743
Method:                      Least Squares   F-statistic:
1.599e+04
Date:                     Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                             14:26:13   Log-Likelihood:
-12071.
No. Observations:                     5535   AIC:
2.415e+04
Df Residuals:                         5533   BIC:
2.416e+04
Df Model:                                1
Covariance Type:                 nonrobust
==============================================================================
=========
                            coef    std err          t      P>|t|      [0.025
0.975]
------------------------------------------------------------------------------
---------
const                    -0.8853      0.044    -19.926      0.000      -0.972
```

```
-0.798
QQQ_Rolling_Return_5y     5.2054      0.041    126.462      0.000       5.125
5.286
==============================================================================
Omnibus:                      314.365   Durbin-Watson:                   0.009
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              460.149
Skew:                           0.498   Prob(JB):                    1.20e-100
Kurtosis:                       4.002   Cond. No.                         2.73
==============================================================================

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

You're welcome to digest each plot, but here's my observations on the above results:

- 1d: TQQQ tracks QQQ as expected (it's a 3x daily return leveraged ETF after all), with a regression coefficient of 2.96 and an R^2 of 0.997, and we extrapolated half the data with the same coefficient.
- 1w: Essentially the same as above. A few outliers, but the regression coefficient is still 2.95 with an R^2 of 0.994. We see a slight skew toward the positive in the rolling returns.
- 1m: The skew toward the positive is more pronounced, and we see more outliers. The regression coefficient has decreased to 2.93 and the R^2 has dropped to 0.98, which is still very high, but we are starting to see some dispersion in the returns.
- 3m: The skew toward the positive is even more pronounced, and we see even more outliers. The regression coefficient has *increased*, to 2.98 and the R^2 has dropped to 0.96.
- 6m: The skew toward the positive is very pronounced, and we see a significant number of outliers with pronounced curvanture in the plot. The regression coefficient has increased again, to 3.4 and the R^2 has dropped to 0.92.
- 1y: At this point, based on the plot and the regression results, we can start to see that the returns of TQQQ are no longer tracking 3x the returns of QQQ as closely as they did in the shorter time periods. The regression coefficient has is now 2.84 and the R^2 has dropped to 0.88.
- 4y and 5y: We can see that there are periods where the rolling returns of TQQQ are significantly higher *and* lower than 3x the returns of QQQ, which is consistent with the idea of volatility decay. For 4y, based on the regression results, we see that if the rolling return of QQQ was 0, then we would expect a return of -0.30x for TQQQ.

$$r_{TQQQ} = -0.30 + 3.93 \times r_{QQQ} = -0.30 + 3.93 \times 0 = -0.30$$

On the other end of the spectrum, if the rolling return of QQQ was 1, then we would expect a return of:

$$r_{TQQQ} = -0.30 + 3.93 \times r_{QQQ} = -0.30 + 3.93 \times 1 = 3.63$$

In general, the positive skew of the rolling returns of TQQQ relative to QQQ is related to the general postive return performance of QQQ. With sustained positive returns, the leverage effect of TQQQ will amplify those returns, leading to a positive skew. However, during periods of negative returns for QQQ, the leverage effect will also amplify those losses, leading to a negative skew, and to the limit of cumulative return of -1, or a 100% loss. The overall skewness of the rolling returns will depend on the balance of these positive and negative periods.

0.4.7 Rolling Returns Deviation (QQQ & TQQQ)

Next, we will the rolling returns deviation from the expected 3x return for each time period. This will give us a better picture of the volatility decay effect and how it changes over different time horizons.

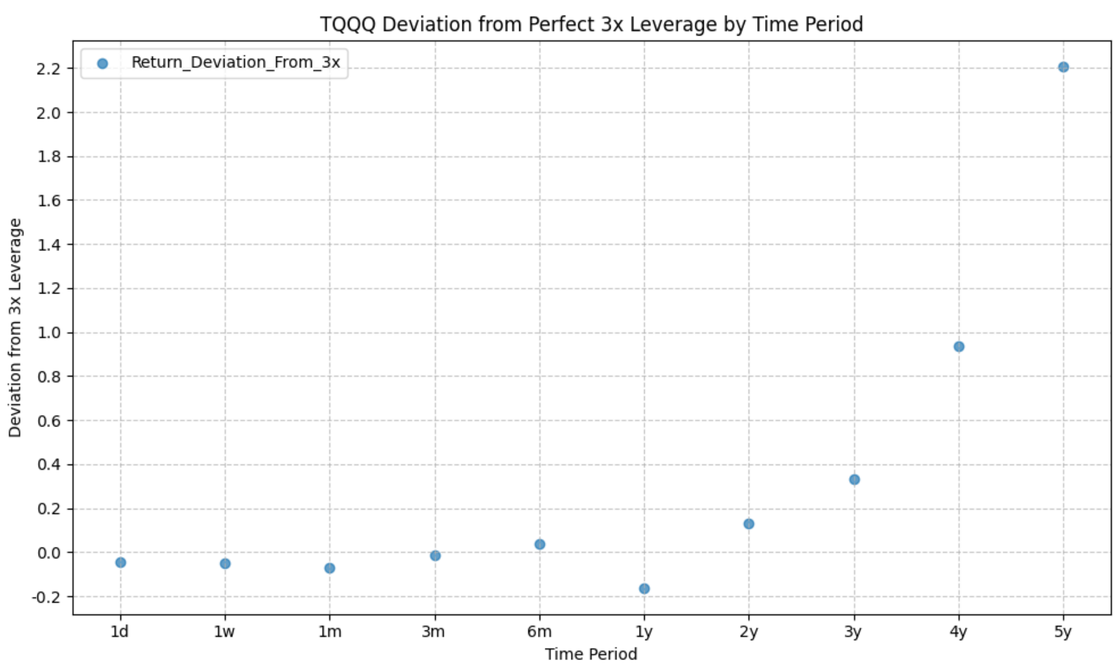
[29]:
```
rolling_returns_stats["Return_Deviation_From_3x"] =␣
↪rolling_returns_stats["Slope"] - 3.0
```

[30]:
```
display(rolling_returns_stats)
```

```
  Period  Intercept     Slope  R_Squared       Skew  Average Upside Beta  \
0     1d  -0.000051  2.955114   0.999059        NaN             2.956838
0     1w  -0.000811  2.952376   0.993954        NaN             2.552537
0     1m  -0.003671  2.930530   0.982002        NaN             2.208871
0     3m  -0.008268  2.984796   0.958372        NaN             1.994392
0     6m  -0.009598  3.039561   0.915755  -8.732599             1.485007
0     1y   0.019061  2.837467   0.879741        NaN             1.222436
0     2y   0.009554  3.131370   0.848505  36.154365             1.393182
0     3y  -0.059935  3.332134   0.804313        NaN            -0.091088
0     4y  -0.292179  3.934252   0.781391  19.553878             1.759839
0     5y  -0.885319  5.205432   0.742959  43.020977             2.433454

   Average Downside Beta  Asymmetry  Return_Deviation_From_3x
0                    NaN        NaN                 -0.044886
0                    NaN        NaN                 -0.047624
0                    NaN        NaN                 -0.069470
0                   -inf        inf                 -0.015204
0               5.416075  -3.931068                  0.039561
0                   -inf        inf                 -0.162533
0              12.341258 -10.948076                  0.131370
0                   -inf        inf                  0.332134
0               7.211475  -5.451636                  0.934252
0              11.479352  -9.045897                  2.205432
```

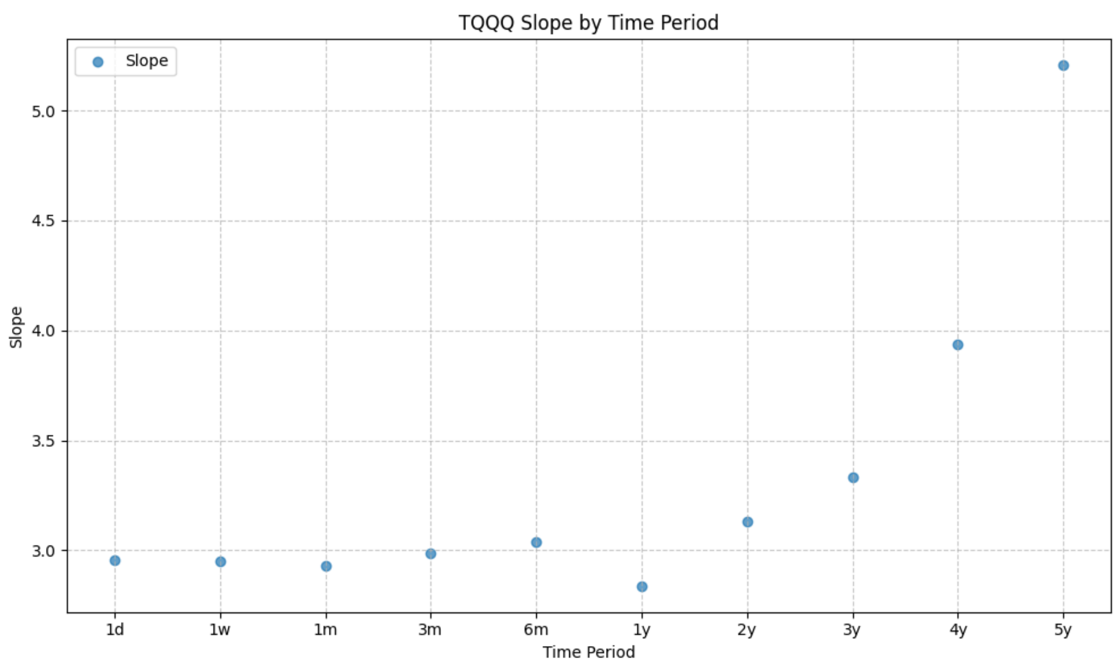
[31]:
```
plot_scatter(
    df=rolling_returns_stats,
    x_plot_column="Period",
    y_plot_columns=["Return_Deviation_From_3x"],
    title="TQQQ Deviation from Perfect 3x Leverage by Time Period",
    x_label="Time Period",
    x_format="String",
    x_format_decimal_places=0,
    x_tick_spacing=1,
```

```
    x_tick_rotation=0,
    y_label="Deviation from 3x Leverage",
    y_format="Decimal",
    y_format_decimal_places=1,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=False,
    OLS_column=None,
    plot_Ridge_regression_line=False,
    Ridge_column=None,
    plot_RidgeCV_regression_line=False,
    RidgeCV_column=None,
    regression_constant=False,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



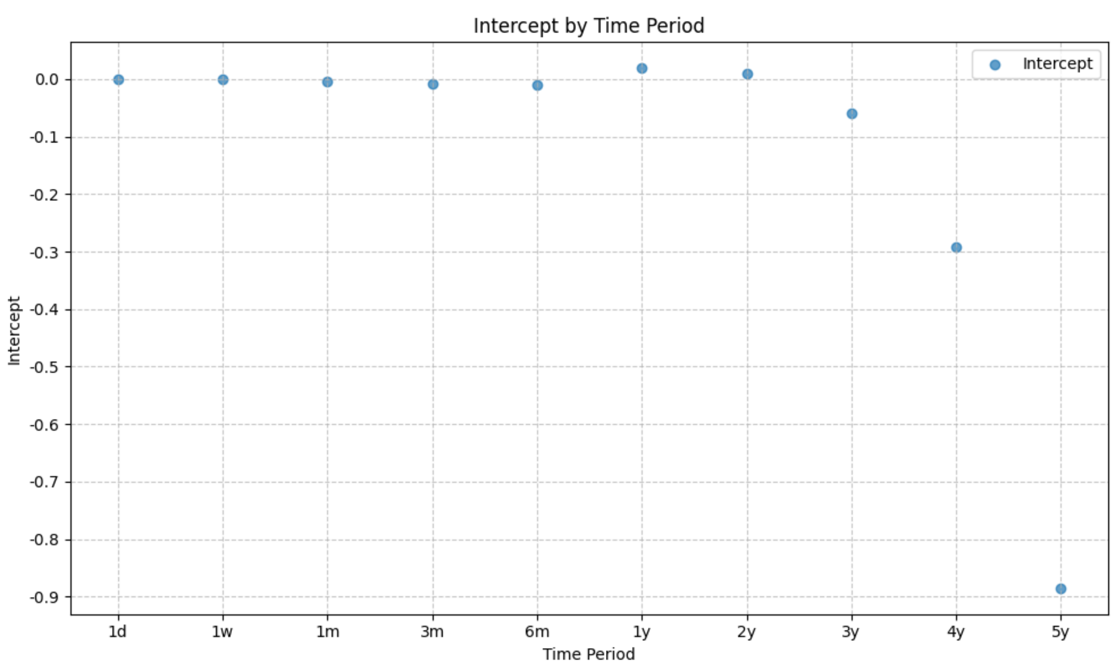
[32]:
```
plot_scatter(
    df=rolling_returns_stats,
    x_plot_column="Period",
    y_plot_columns=["Slope"],
    title="TQQQ Slope by Time Period",
    x_label="Time Period",
```

```
    x_format="String",
    x_format_decimal_places=0,
    x_tick_spacing=1,
    x_tick_rotation=0,
    y_label="Slope",
    y_format="Decimal",
    y_format_decimal_places=1,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=False,
    OLS_column=None,
    plot_Ridge_regression_line=False,
    Ridge_column=None,
    plot_RidgeCV_regression_line=False,
    RidgeCV_column=None,
    regression_constant=False,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



[33]:
```
plot_scatter(
    df=rolling_returns_stats,
    x_plot_column="Period",
```

```
    y_plot_columns=["Intercept"],
    title="Intercept by Time Period",
    x_label="Time Period",
    x_format="String",
    x_format_decimal_places=0,
    x_tick_spacing=1,
    x_tick_rotation=0,
    y_label="Intercept",
    y_format="Decimal",
    y_format_decimal_places=1,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=False,
    OLS_column=None,
    plot_Ridge_regression_line=False,
    Ridge_column=None,
    plot_RidgeCV_regression_line=False,
    RidgeCV_column=None,
    regression_constant=False,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



[34]:
```
pandas_set_decimal_places(3)
display(rolling_returns_stats.set_index("Period"))
```

```
        Intercept  Slope  R_Squared   Skew  Average Upside Beta  \
Period
1d         -0.000  2.955      0.999    NaN                2.957
1w         -0.001  2.952      0.994    NaN                2.553
1m         -0.004  2.931      0.982    NaN                2.209
3m         -0.008  2.985      0.958    NaN                1.994
6m         -0.010  3.040      0.916 -8.733                1.485
1y          0.019  2.837      0.880    NaN                1.222
2y          0.010  3.131      0.849 36.154                1.393
3y         -0.060  3.332      0.804    NaN               -0.091
4y         -0.292  3.934      0.781 19.554                1.760
5y         -0.885  5.205      0.743 43.021                2.433

        Average Downside Beta  Asymmetry  Return_Deviation_From_3x
Period
1d                        NaN        NaN                    -0.045
1w                        NaN        NaN                    -0.048
1m                        NaN        NaN                    -0.069
3m                       -inf        inf                    -0.015
6m                      5.416     -3.931                     0.040
1y                       -inf        inf                    -0.163
2y                     12.341    -10.948                     0.131
3y                       -inf        inf                     0.332
4y                      7.211     -5.452                     0.934
5y                     11.479     -9.046                     2.205
```

This is very interesting. Up to 1 year, there is minimal difference between the mean TQQQ 1 year rolling return and the hypothetical 3x leverage, with an R^2 of greater than 0.9.

However, as we extend the time period, we see that

- The "leverage factor" increases significantly, resulting in a deviation from the perfect 3x leverage.
- The intercept also begins to deviate significantly from 0.

The above highlight the impact of volatility magnification over longer time horizons. This phenomenon is happening likely due to the positive returns that QQQ has achieved over the past 15 years - resulting in TQQQ compounding at a much higher rate than 3x - but it may and likely is not exhibited by other 3x leveraged ETFs that have not had the same positive return profile as QQQ.

With the above results, the next logical question is, when is the opportune time to buy a 3x leveraged ETF like TQQQ? To answer this, we will look a the drawdown levels of TQQQ and the subsequent returns over various time horizons.

0.4.8 Rolling Returns Following Drawdowns (QQQ & TQQQ)

We will identify the drawdown levels of TQQQ and then look at the subsequent rolling returns over various time horizons.

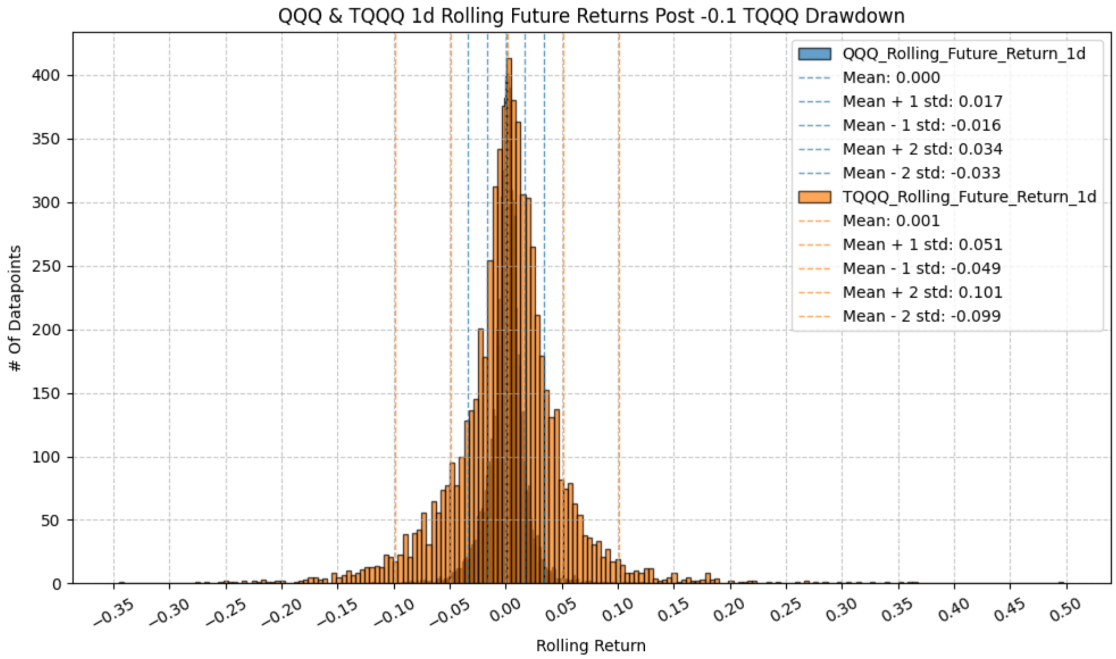
[35]:
```
# Copy DataFrame
qqq_tqqq_extrap_future = qqq_tqqq_extrap.copy()

# Create a list of drawdown levels to analyze
drawdown_levels = [-0.10, -0.20, -0.30, -0.40, -0.50, -0.60, -0.70, -0.80]

# Shift the rolling return columns by the number of days in the rolling window␣
↪to get the returns following the drawdown
for etf in etfs:
    for period_name, window in rolling_windows.items():
        qqq_tqqq_extrap_future[f"{etf}_Rolling_Future_Return_{period_name}"] =␣
↪qqq_tqqq_extrap_future[f"{etf}_Rolling_Return_{period_name}"].shift(-window)
```

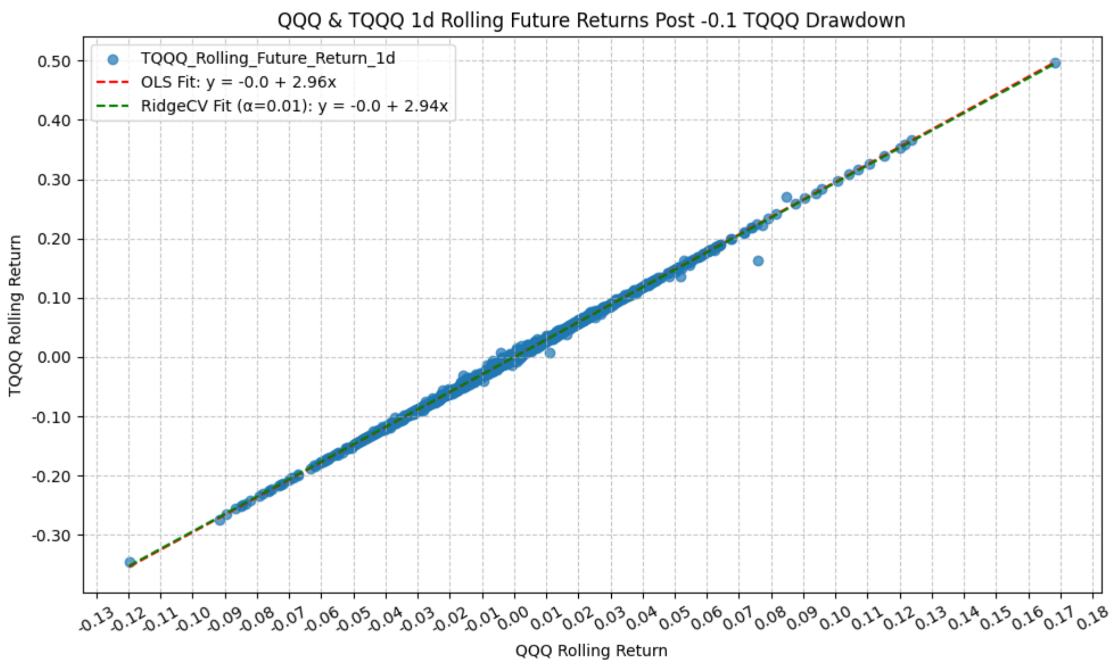
Now, we can analyze the future rolling returns following specific drawdown levels:

[36]:
```
# Create a dataframe to hold rolling returns stats
rolling_returns_drawdown_stats = pd.DataFrame()

for drawdown in drawdown_levels:

    for period_name, window in rolling_windows.items():

        try:
            plot_histogram(
                ␣
↪df=qqq_tqqq_extrap_future[qqq_tqqq_extrap_future["TQQQ_Drawdown"] <=␣
↪drawdown],
                plot_columns=[f"QQQ_Rolling_Future_Return_{period_name}",␣
↪f"TQQQ_Rolling_Future_Return_{period_name}"],
                title=f"QQQ & TQQQ {period_name} Rolling Future Returns Post␣
↪{drawdown} TQQQ Drawdown",
                x_label="Rolling Return",
                x_tick_spacing="Auto",
                x_tick_rotation=30,
                y_label="# Of Datapoints",
                y_tick_spacing="Auto",
                y_tick_rotation=0,
                grid=True,
                legend=True,
                export_plot=False,
                plot_file_name=None,
            )
```

```
            plot_scatter(
               ␣
↪df=qqq_tqqq_extrap_future[qqq_tqqq_extrap_future["TQQQ_Drawdown"] <=␣
↪drawdown],
                x_plot_column=f"QQQ_Rolling_Future_Return_{period_name}",
                y_plot_columns=[f"TQQQ_Rolling_Future_Return_{period_name}"],
                title=f"QQQ & TQQQ {period_name} Rolling Future Returns Post␣
↪{drawdown} TQQQ Drawdown",
                x_label="QQQ Rolling Return",
                x_format="Decimal",
                x_format_decimal_places=2,
                x_tick_spacing="Auto",
                x_tick_rotation=30,
                y_label="TQQQ Rolling Return",
                y_format="Decimal",
                y_format_decimal_places=2,
                y_tick_spacing="Auto",
                y_tick_rotation=0,
                plot_OLS_regression_line=True,
                OLS_column=f"TQQQ_Rolling_Future_Return_{period_name}",
                plot_Ridge_regression_line=False,
                Ridge_column=None,
                plot_RidgeCV_regression_line=True,
                RidgeCV_column=f"TQQQ_Rolling_Future_Return_{period_name}",
                regression_constant=True,
                grid=True,
                legend=True,
                export_plot=False,
                plot_file_name=None,
            )

            # Run OLS regression with statsmodels
            model = run_linear_regression(
               ␣
↪df=qqq_tqqq_extrap_future[qqq_tqqq_extrap_future["TQQQ_Drawdown"] <=␣
↪drawdown],
                x_plot_column=f"QQQ_Rolling_Future_Return_{period_name}",
                y_plot_column=f"TQQQ_Rolling_Future_Return_{period_name}",
                regression_model="OLS-statsmodels",
                regression_constant=True,
            )
            print(model.summary())

            # Filter by drawdown
            drawdown_filter =␣
↪qqq_tqqq_extrap_future[qqq_tqqq_extrap_future["TQQQ_Drawdown"] <= drawdown]
```

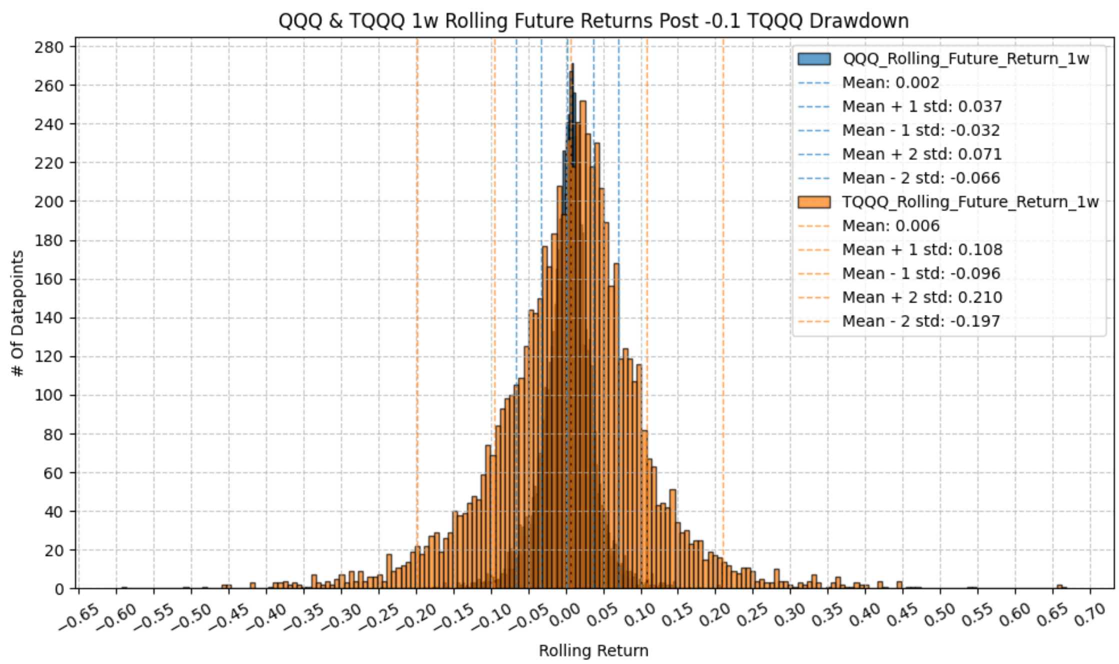
```
            # Filter by period, drop rows with missing values
            future_filter =␣
↪drawdown_filter[[f"TQQQ_Rolling_Future_Return_{period_name}"]].dropna()

            # Find length of future dataframe
            future_length = len(future_filter)

            # Find length of future dataframe where return is positive
            positive_future_length =␣
↪len(future_filter[future_filter[f"TQQQ_Rolling_Future_Return_{period_name}"]␣
↪> 0])

            # Calculate percentage of future returns that are positive
            positive_future_percentage = (positive_future_length /␣
↪future_length) if future_length > 0 else 0

            # Add the regression results to the rolling returns stats dataframe
            intercept = model.params[0]
            # intercept_pvalue = model.pvalues[0]   # p-value for Intercept
            slope = model.params[1]
            # slope_pvalue = model.pvalues[1]       # p-value for Slope
            r_squared = model.rsquared

            rolling_returns_slope_int = pd.DataFrame({
                "Drawdown": drawdown,
                "Period": period_name,
                "Intercept": [intercept],
                # "Intercept_PValue": [intercept_pvalue],
                "Slope": [slope],
                # "Slope_PValue": [slope_pvalue],
                "R_Squared": [r_squared],
                "Positive_Future_Percentage": [positive_future_percentage],
            })

            rolling_returns_drawdown_stats = pd.
↪concat([rolling_returns_drawdown_stats, rolling_returns_slope_int])

        except:
            print(f"Not enough data points for drawdown level {drawdown} and␣
↪period {period_name} to run regression.")
```

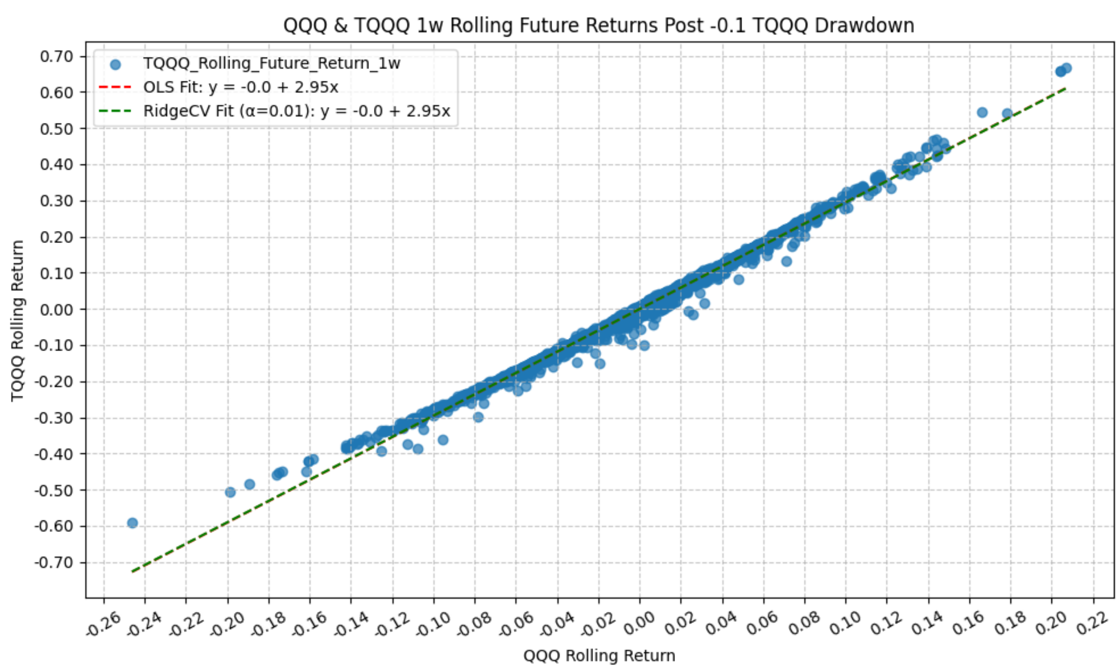





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1d   R-squared:
```

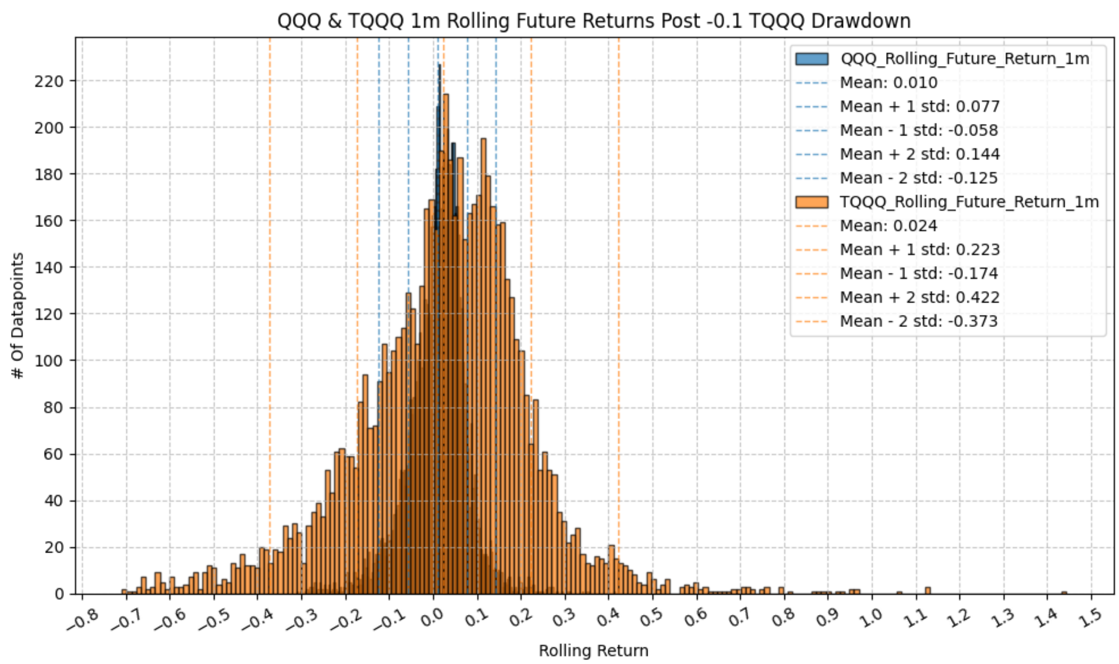
```
0.999
Model:                                OLS   Adj. R-squared:
0.999
Method:                     Least Squares   F-statistic:
6.825e+06
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:15   Log-Likelihood:
33542.
No. Observations:                    6648   AIC:
-6.708e+04
Df Residuals:                        6646   BIC:
-6.707e+04
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                       -5.203e-05   1.91e-05     -2.721      0.007
-8.95e-05   -1.45e-05
QQQ_Rolling_Future_Return_1d     2.9551      0.001   2612.377      0.000
2.953       2.957
==============================================================================
Omnibus:                     9913.687   Durbin-Watson:                   2.565
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         41109927.245
Skew:                          -8.187   Prob(JB):                         0.00
Kurtosis:                     387.894   Cond. No.                         59.2
==============================================================================

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

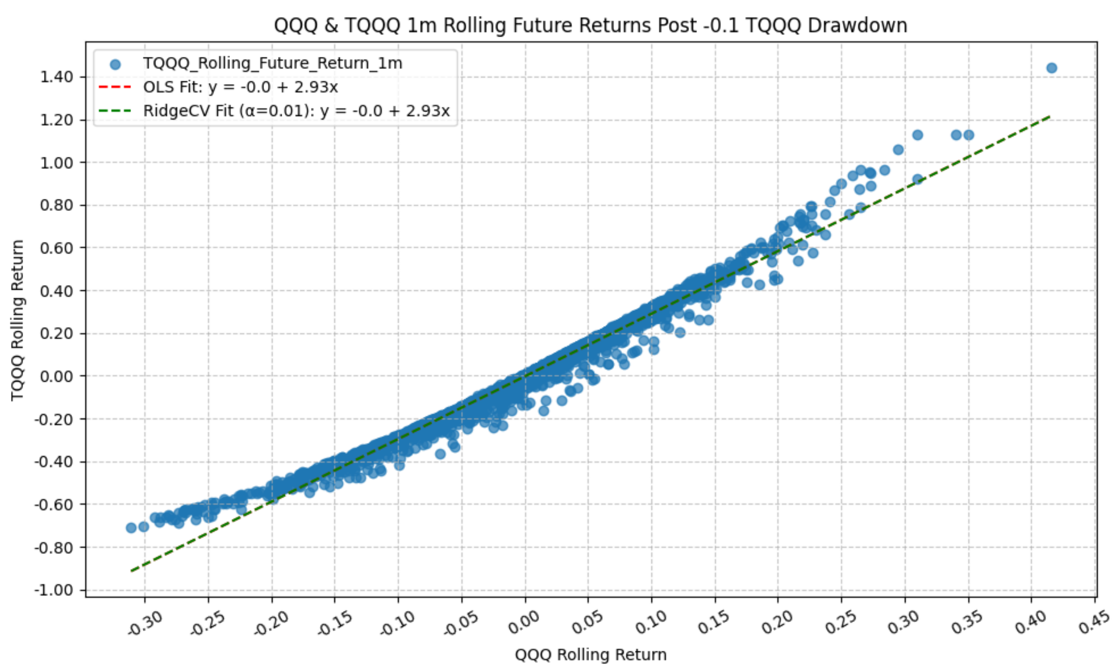





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_1w   R-squared:
```

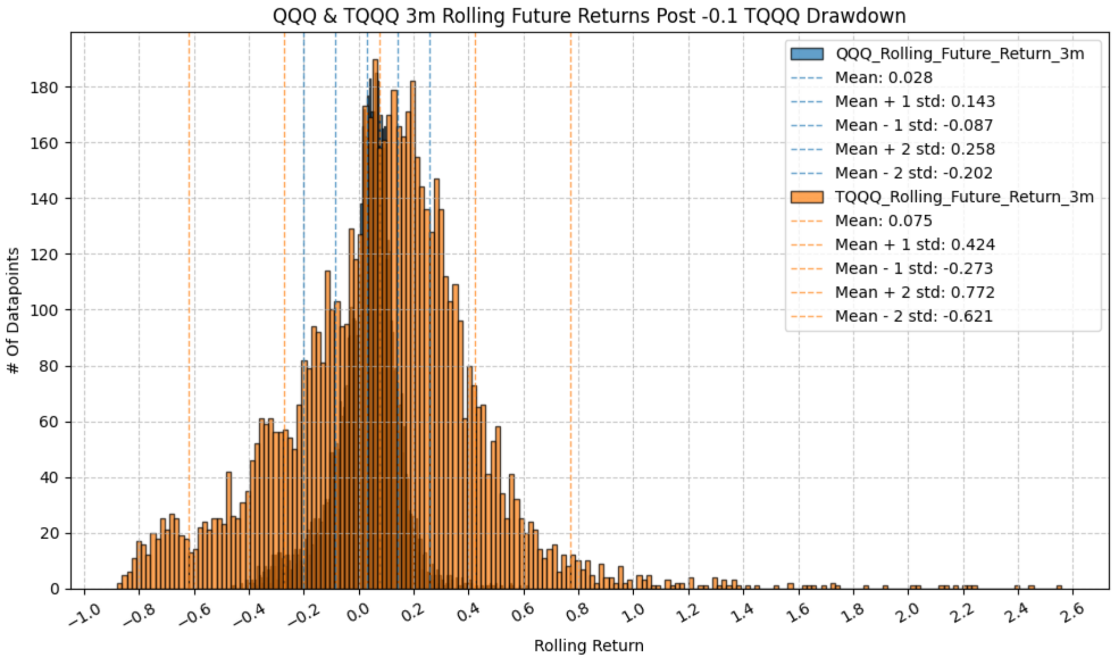
```
0.994
Model:                            OLS   Adj. R-squared:
0.994
Method:                 Least Squares   F-statistic:
1.088e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:16   Log-Likelihood:
22709.
No. Observations:                6644   AIC:
-4.541e+04
Df Residuals:                    6642   BIC:
-4.540e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0008   9.76e-05     -8.221      0.000
-0.001      -0.001
QQQ_Rolling_Future_Return_1w   2.9526      0.003   1043.242      0.000
2.947       2.958
==============================================================================
Omnibus:                     2701.400   Durbin-Watson:                   0.939
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           586368.143
Skew:                          -0.779   Prob(JB):                         0.00
Kurtosis:                      48.997   Cond. No.                         29.1
==============================================================================

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

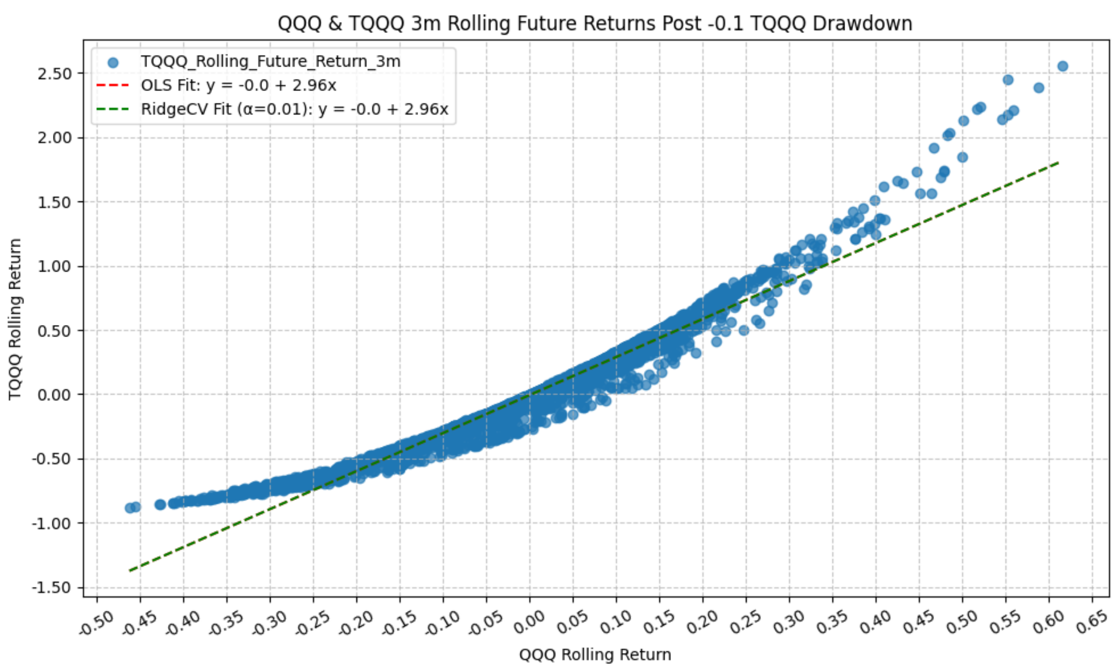





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1m   R-squared:
```

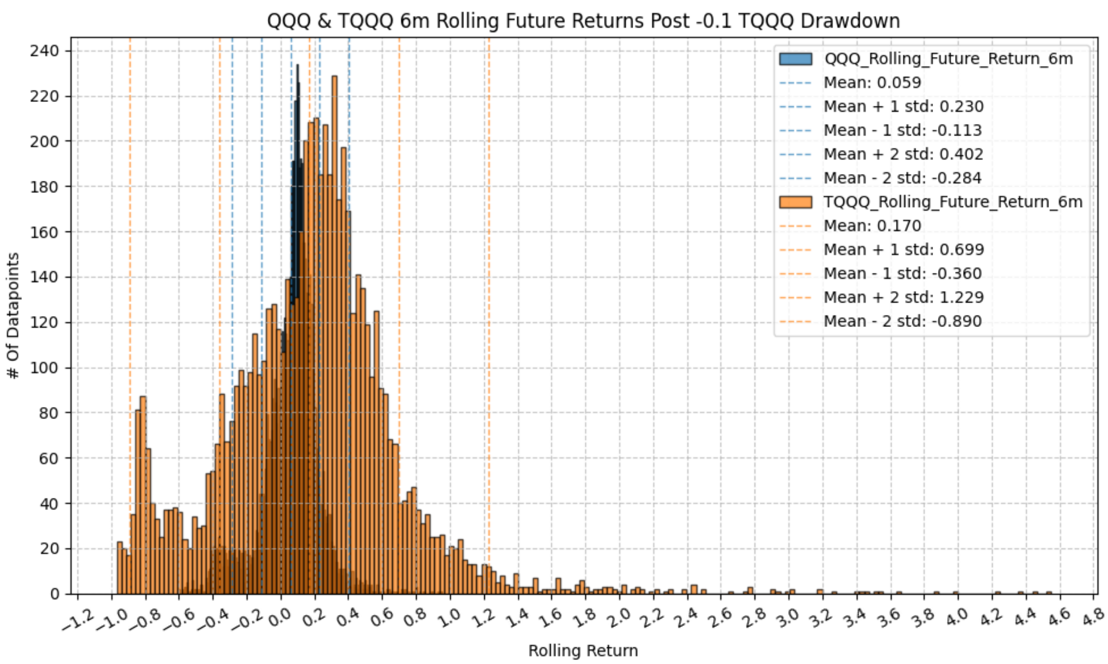
```
0.982
Model:                                OLS   Adj. R-squared:
0.982
Method:                     Least Squares   F-statistic:
3.703e+05
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:17   Log-Likelihood:
14696.
No. Observations:                    6628   AIC:
-2.939e+04
Df Residuals:                        6626   BIC:
-2.937e+04
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0034      0.000    -10.530      0.000
-0.004      -0.003
QQQ_Rolling_Future_Return_1m    2.9304      0.005    608.513      0.000
2.921       2.940
==============================================================================
Omnibus:                     1679.490   Durbin-Watson:                   0.312
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            80862.122
Skew:                           0.393   Prob(JB):                         0.00
Kurtosis:                      20.093   Cond. No.                         14.9
==============================================================================

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

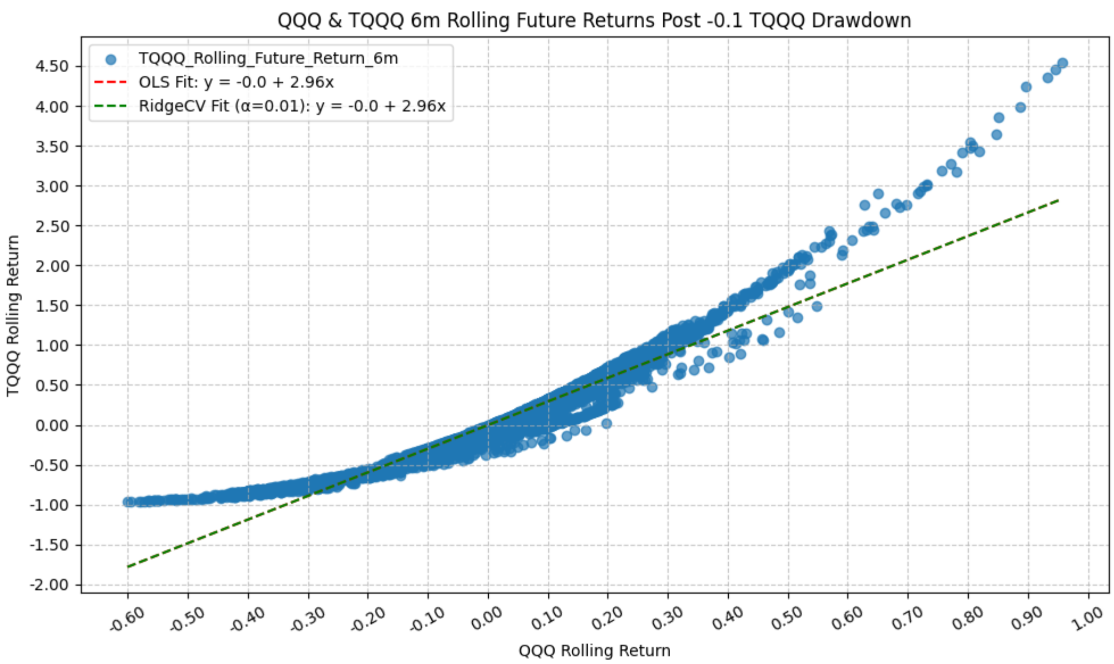





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3m   R-squared:
```

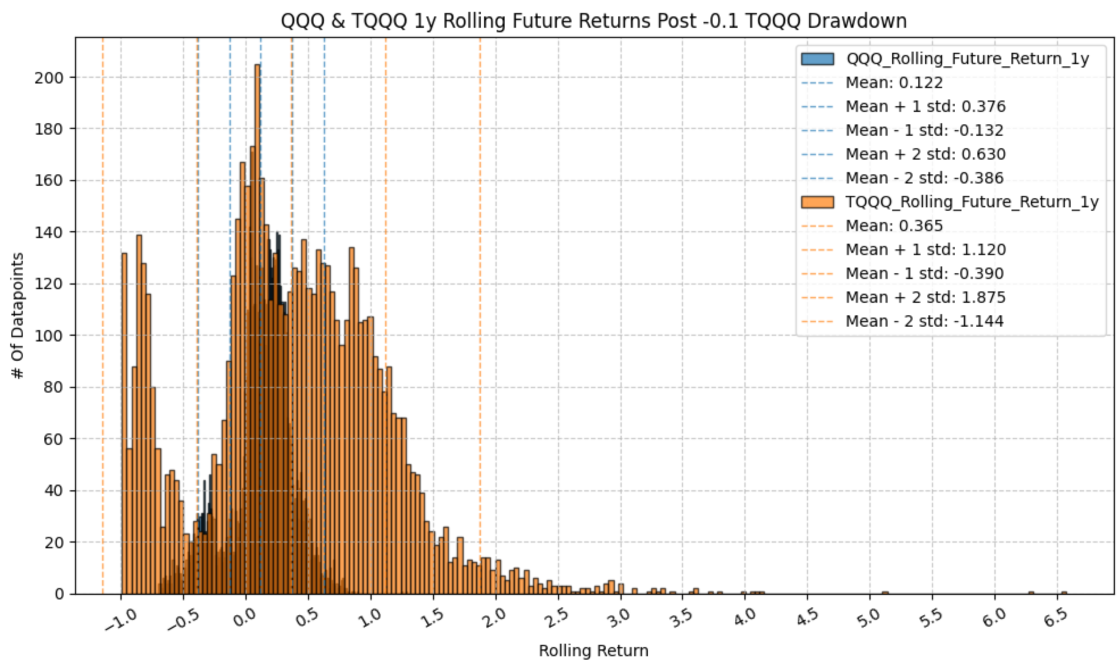
```
0.957
Model:                            OLS   Adj. R-squared:
0.957
Method:                 Least Squares   F-statistic:
1.458e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:18   Log-Likelihood:
7947.5
No. Observations:                6586   AIC:
-1.589e+04
Df Residuals:                    6584   BIC:
-1.588e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0076      0.001     -8.260      0.000
-0.009      -0.006
QQQ_Rolling_Future_Return_3m    2.9582      0.008    381.884      0.000
2.943       2.973
==============================================================================
Omnibus:                     3401.457   Durbin-Watson:                   0.113
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            86281.946
Skew:                           1.942   Prob(JB):                         0.00
Kurtosis:                      20.301   Cond. No.                         8.69
==============================================================================

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

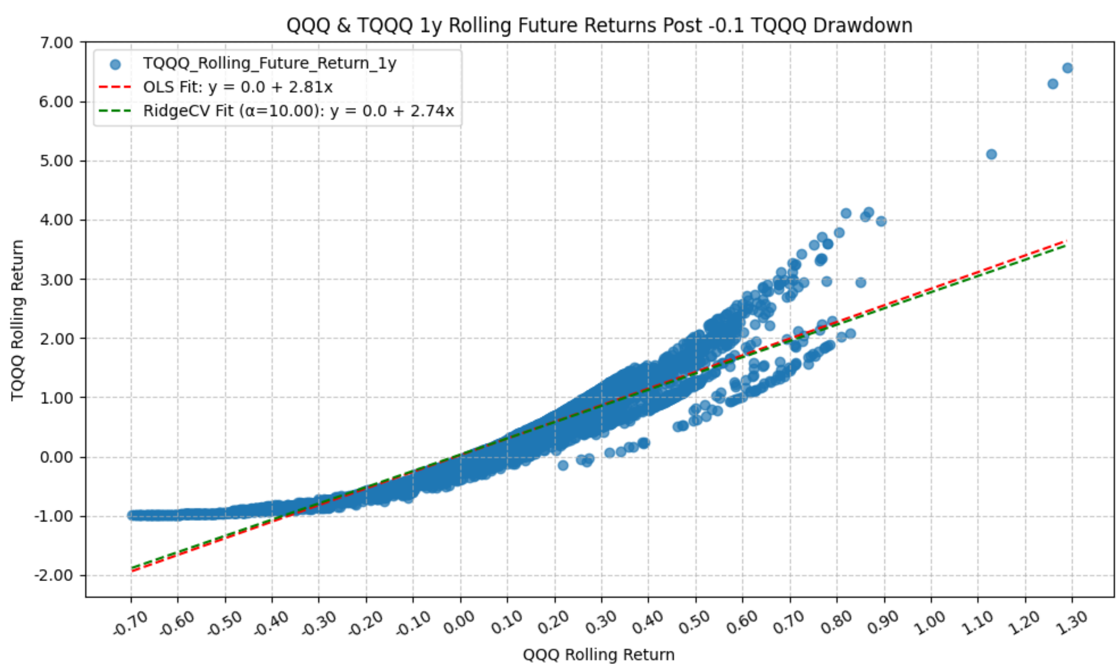





```
                             OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_6m   R-squared:
```

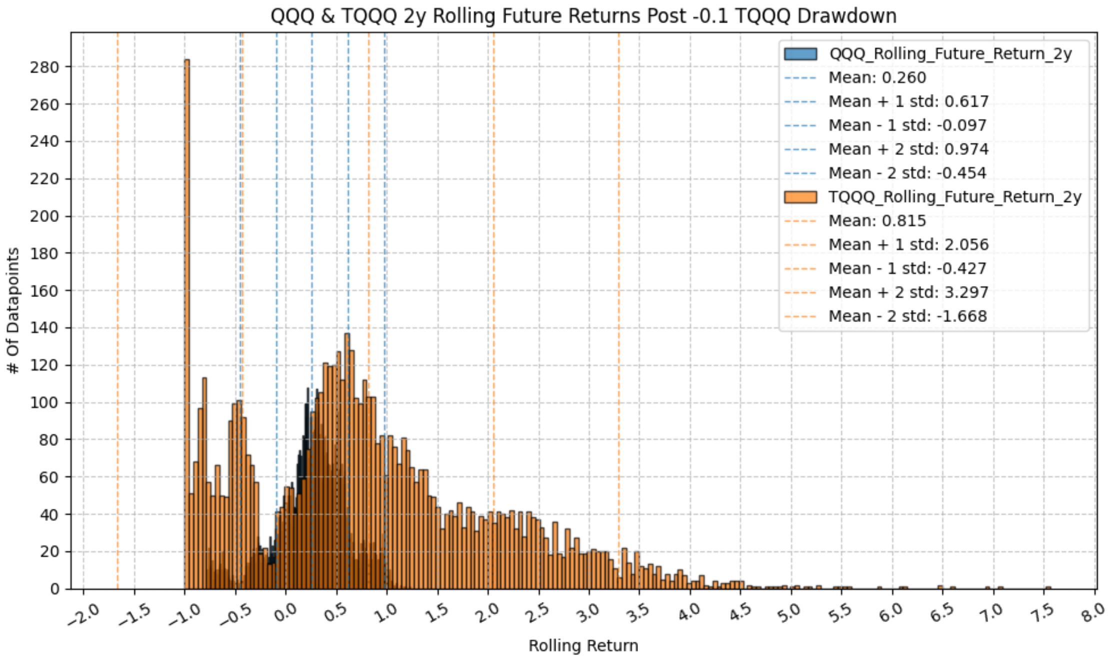
```
0.921
Model:                            OLS   Adj. R-squared:
0.921
Method:                 Least Squares   F-statistic:
7.566e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:20   Log-Likelihood:
3154.5
No. Observations:                6523   AIC:
-6305.
Df Residuals:                    6521   BIC:
-6291.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0042      0.002     -2.132      0.033
-0.008      -0.000
QQQ_Rolling_Future_Return_6m   2.9626      0.011    275.060      0.000
2.941       2.984
==============================================================================
Omnibus:                     4154.198   Durbin-Watson:                   0.065
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           100612.082
Skew:                           2.647   Prob(JB):                         0.00
Kurtosis:                      21.498   Cond. No.                         5.85
==============================================================================

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

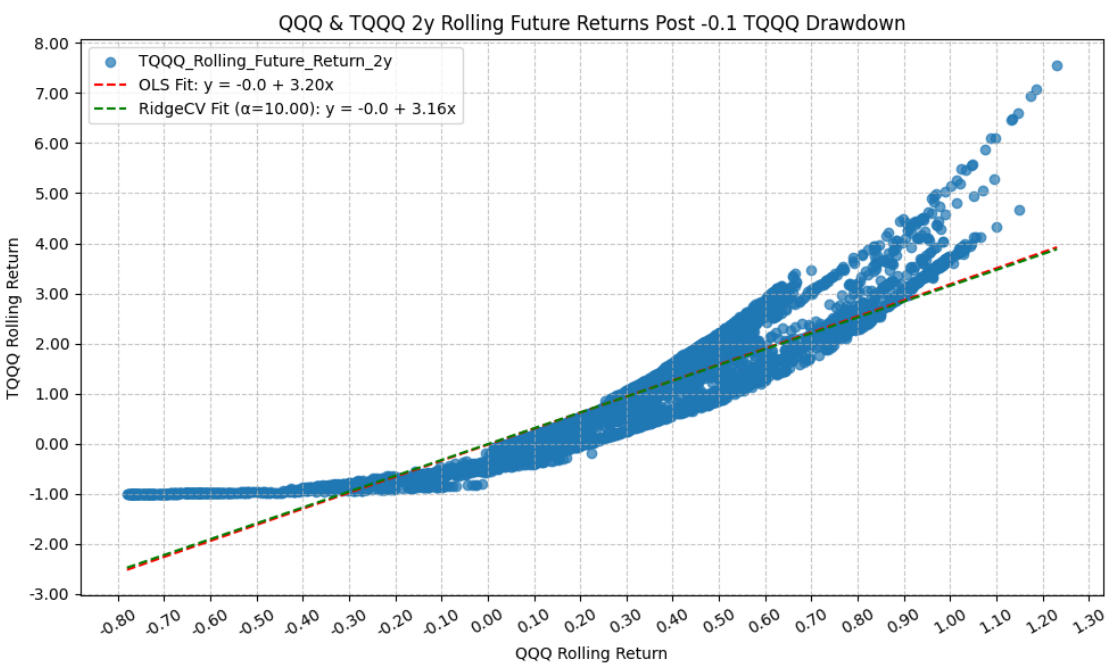





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_1y   R-squared:
```

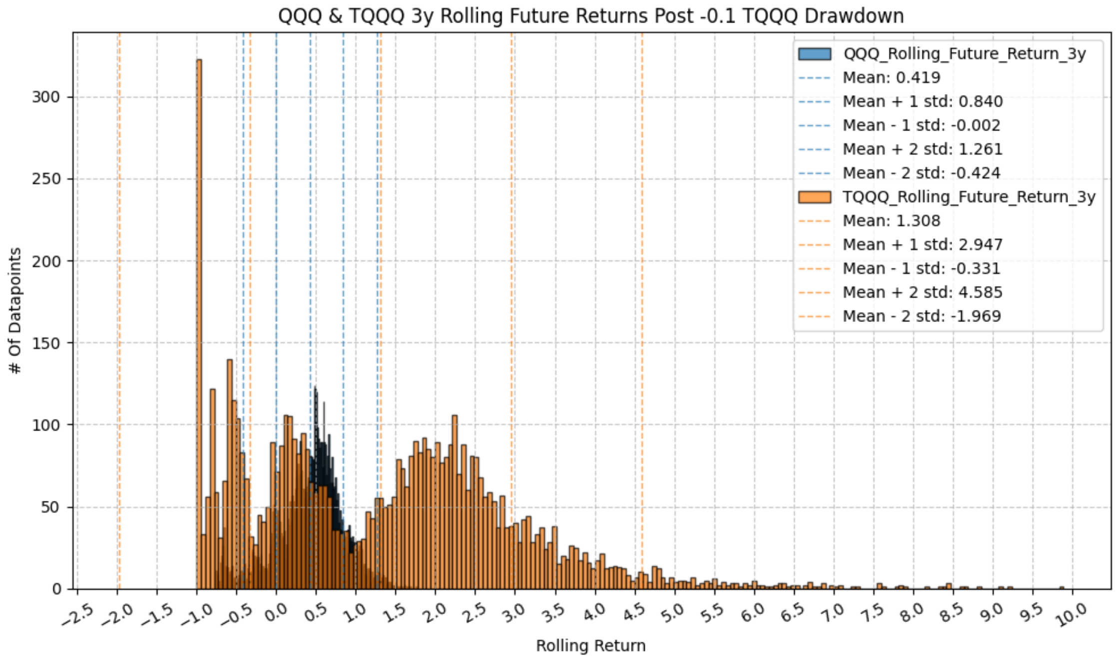
```
0.893
Model:                                    OLS   Adj. R-squared:
0.893
Method:                         Least Squares   F-statistic:
5.326e+04
Date:                        Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                14:26:21   Log-Likelihood:
-135.51
No. Observations:                        6397   AIC:
275.0
Df Residuals:                            6395   BIC:
288.6
Df Model:                                   1
Covariance Type:                    nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          0.0228      0.003      6.654      0.000
0.016       0.030
QQQ_Rolling_Future_Return_1y     2.8089      0.012    230.784      0.000
2.785       2.833
==============================================================================
Omnibus:                     2631.338   Durbin-Watson:                   0.052
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            29220.801
Skew:                           1.657   Prob(JB):                         0.00
Kurtosis:                      12.932   Cond. No.                         4.00
==============================================================================

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

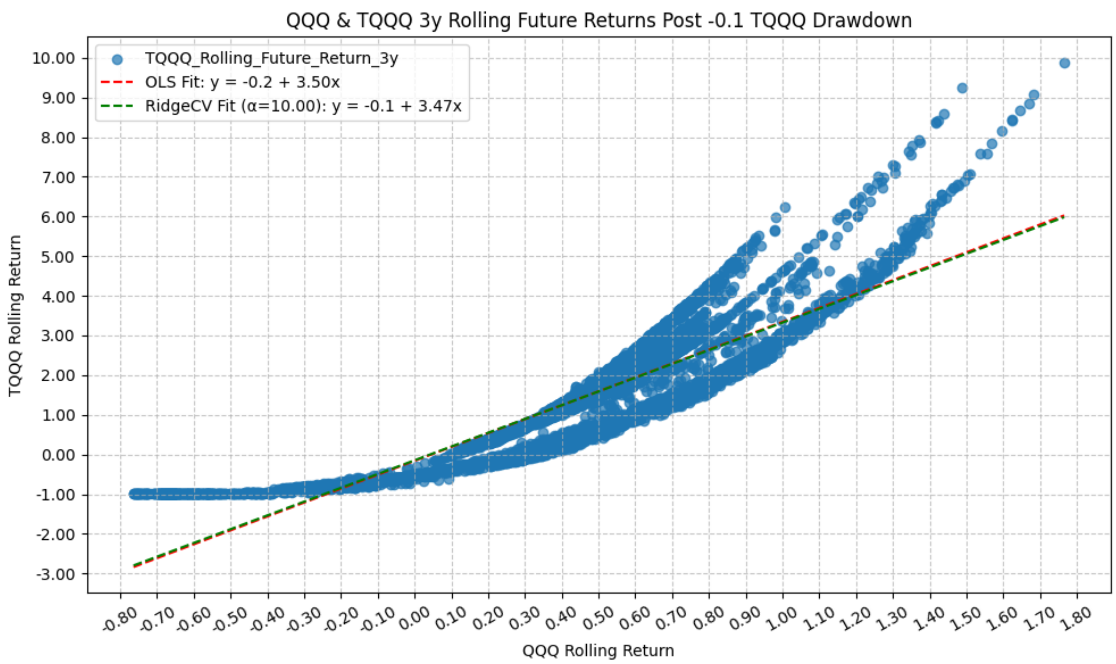





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_2y   R-squared:
```

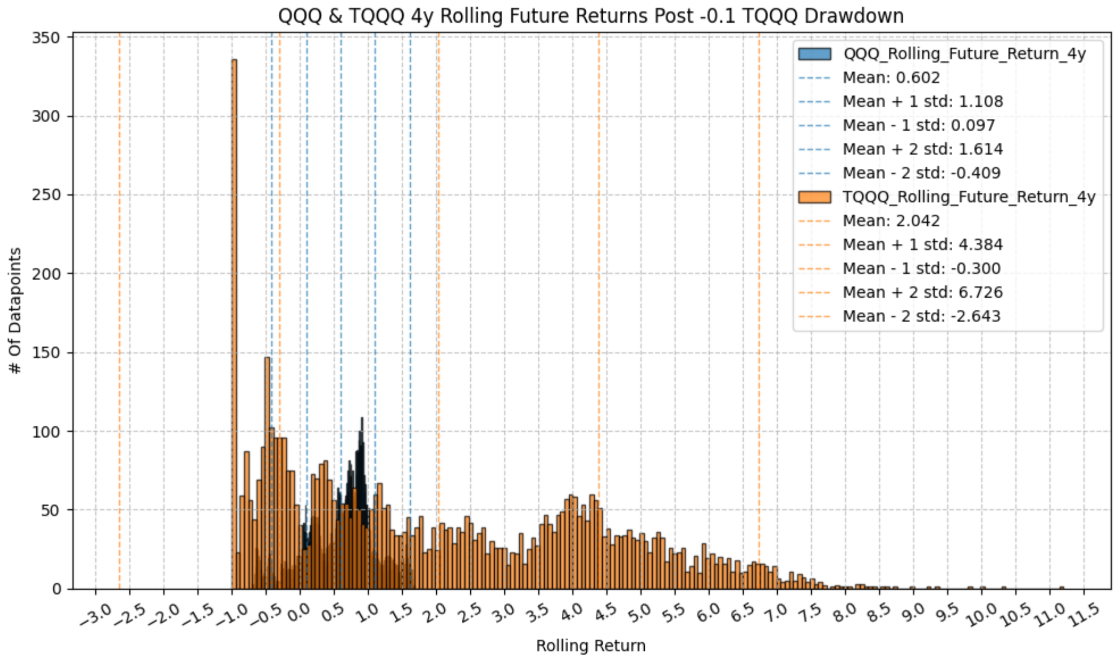
```
0.848
Model:                            OLS   Adj. R-squared:
0.848
Method:                 Least Squares   F-statistic:
3.426e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:22   Log-Likelihood:
-4260.2
No. Observations:                6145   AIC:
8524.
Df Residuals:                    6143   BIC:
8538.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0188      0.008     -2.463      0.014
-0.034      -0.004
QQQ_Rolling_Future_Return_2y    3.2014      0.017    185.083      0.000
3.167       3.235
==============================================================================
Omnibus:                     1670.286   Durbin-Watson:                   0.019
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4641.855
Skew:                           1.436   Prob(JB):                         0.00
Kurtosis:                       6.143   Cond. No.                         3.02
==============================================================================

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

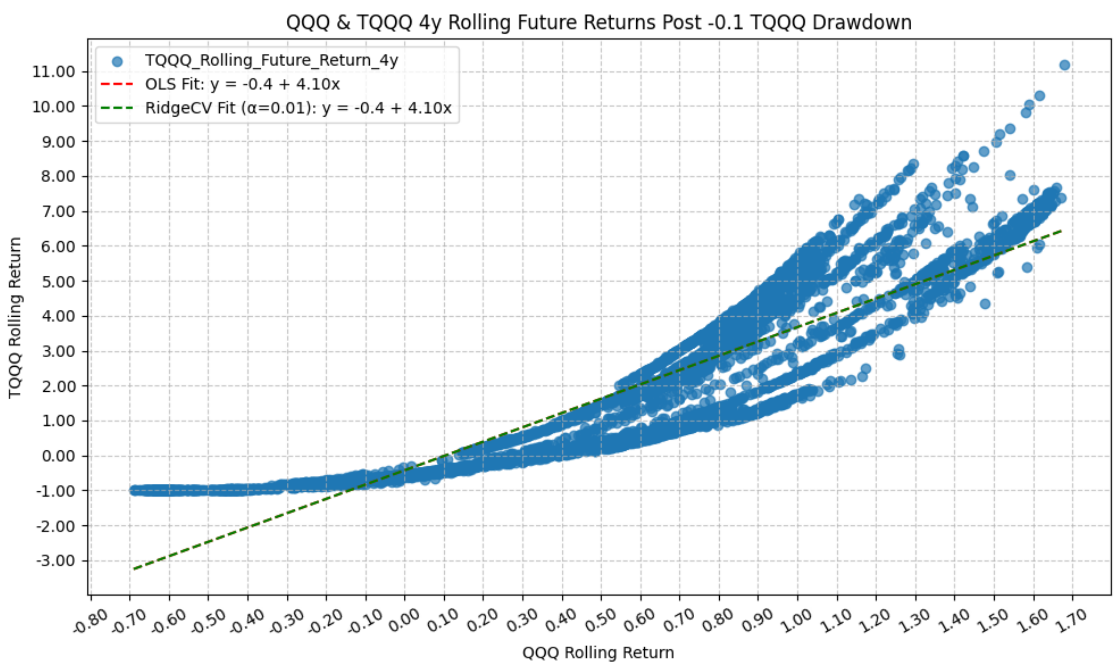





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_3y   R-squared:
```

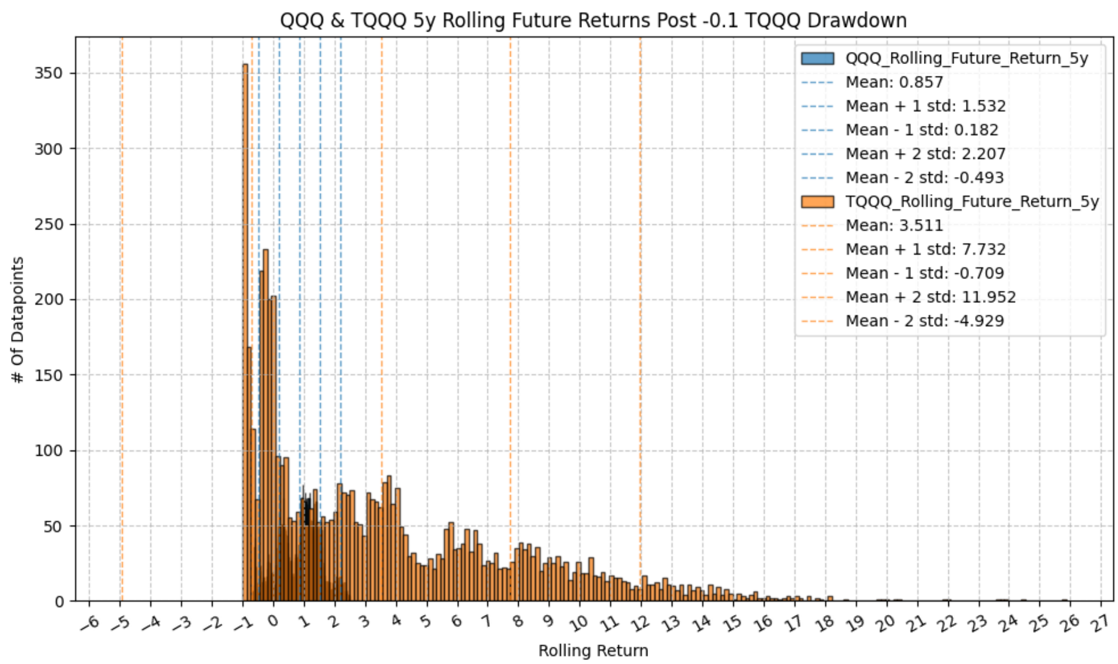
```
0.811
Model:                            OLS   Adj. R-squared:
0.811
Method:                 Least Squares   F-statistic:
2.522e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:23   Log-Likelihood:
-6367.9
No. Observations:                5893   AIC:
1.274e+04
Df Residuals:                    5891   BIC:
1.275e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.1590      0.013    -12.136      0.000
-0.185      -0.133
QQQ_Rolling_Future_Return_3y   3.5025      0.022    158.807      0.000
3.459       3.546
==============================================================================
Omnibus:                      868.866   Durbin-Watson:                   0.015
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1529.067
Skew:                           0.959   Prob(JB):                         0.00
Kurtosis:                       4.595   Cond. No.                         2.86
==============================================================================

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

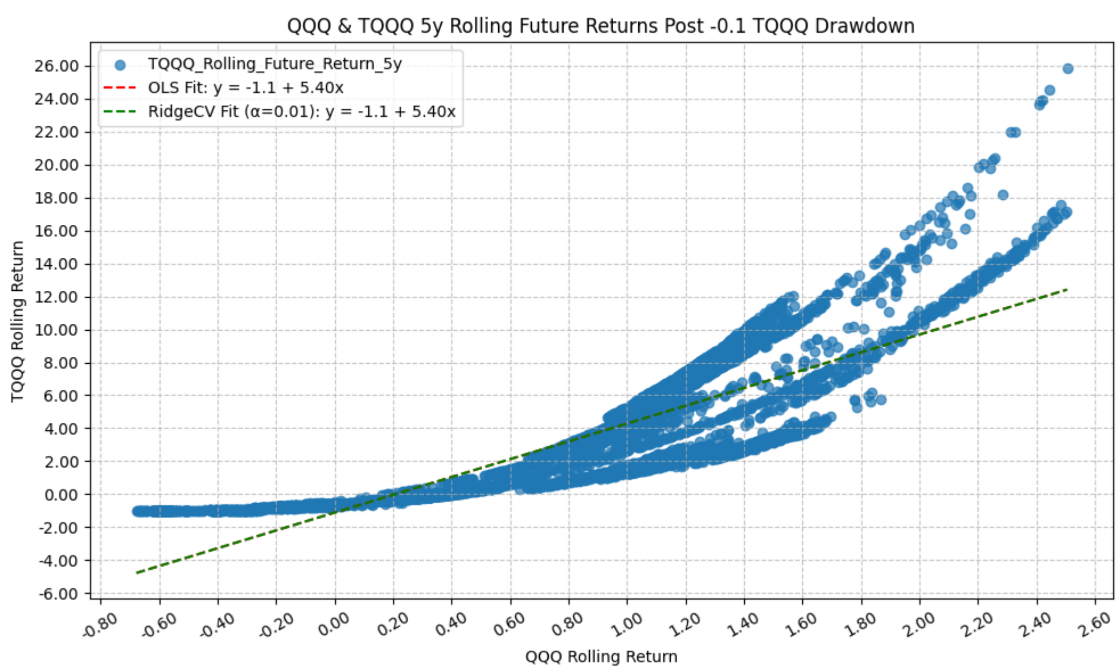





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_4y   R-squared:
```

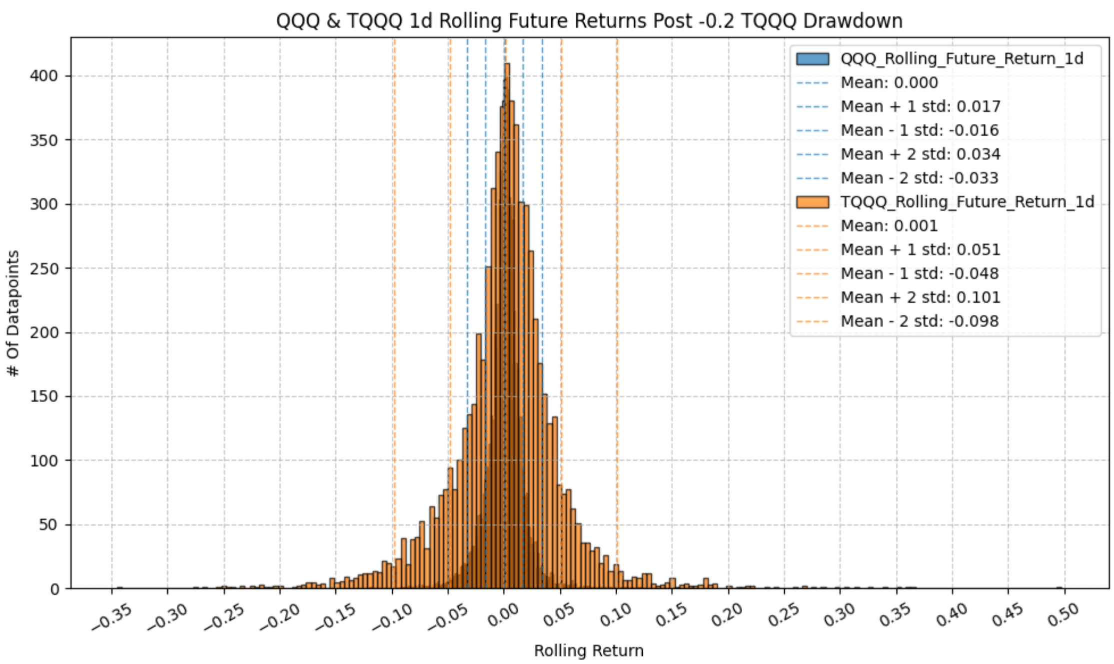
```
0.783
Model:                                      OLS   Adj. R-squared:
0.783
Method:                           Least Squares   F-statistic:
2.039e+04
Date:                          Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                  14:26:24   Log-Likelihood:
-8491.0
No. Observations:                          5641   AIC:
1.699e+04
Df Residuals:                              5639   BIC:
1.700e+04
Df Model:                                     1
Covariance Type:                      nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.4268      0.023    -18.906      0.000
-0.471      -0.383
QQQ_Rolling_Future_Return_4y    4.0976      0.029    142.777      0.000
4.041       4.154
==============================================================================
Omnibus:                      125.491   Durbin-Watson:                   0.010
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               78.475
Skew:                           0.148   Prob(JB):                     9.11e-18
Kurtosis:                       2.504   Cond. No.                         2.85
==============================================================================

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

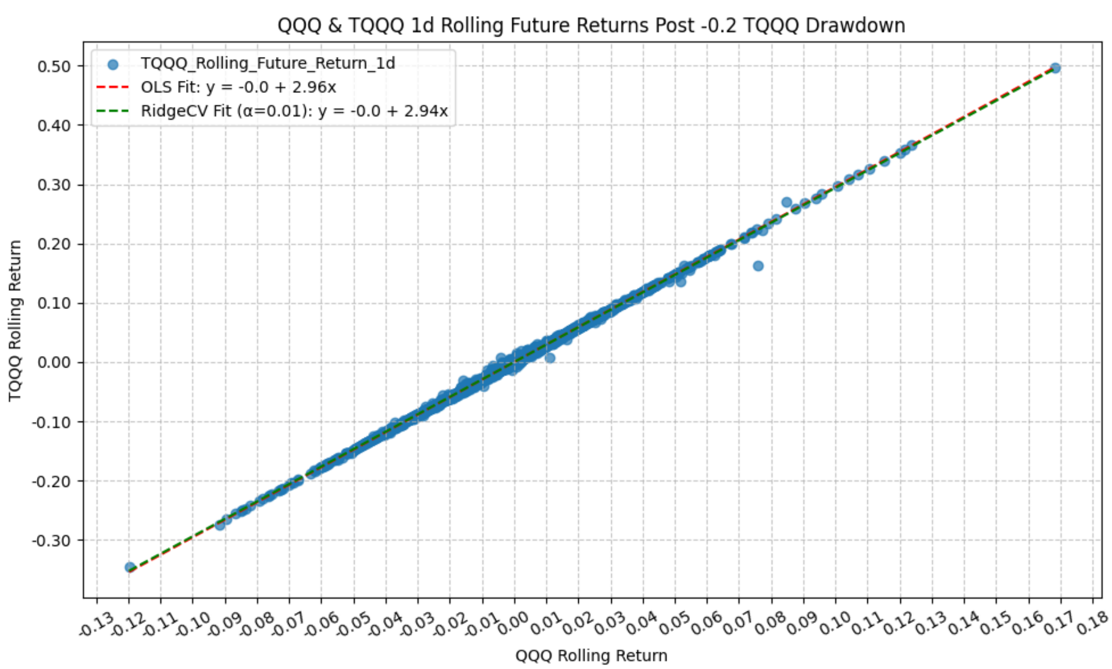





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_5y   R-squared:
```

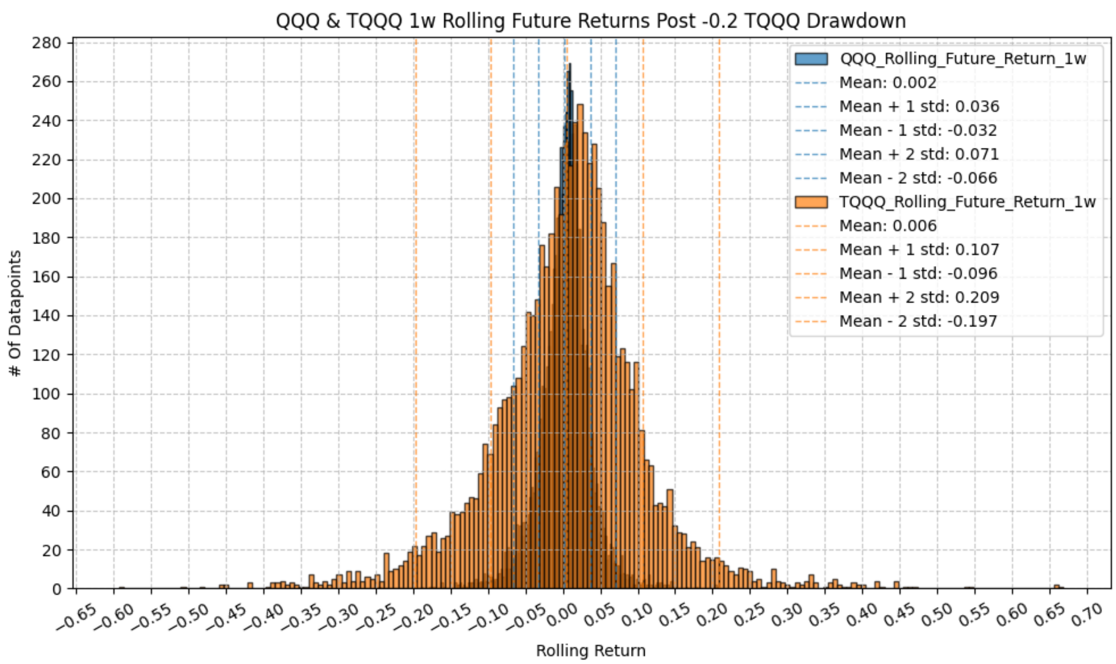
```
0.745
Model:                            OLS   Adj. R-squared:
0.745
Method:                 Least Squares   F-statistic:
1.578e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:25   Log-Likelihood:
-11719.
No. Observations:                5389   AIC:
2.344e+04
Df Residuals:                    5387   BIC:
2.345e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -1.1137      0.047    -23.759      0.000
-1.206      -1.022
QQQ_Rolling_Future_Return_5y   5.3970      0.043    125.610      0.000
5.313       5.481
==============================================================================
Omnibus:                      275.950   Durbin-Watson:                   0.009
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              406.209
Skew:                           0.459   Prob(JB):                     6.21e-89
Kurtosis:                       3.983   Cond. No.                         2.90
==============================================================================

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

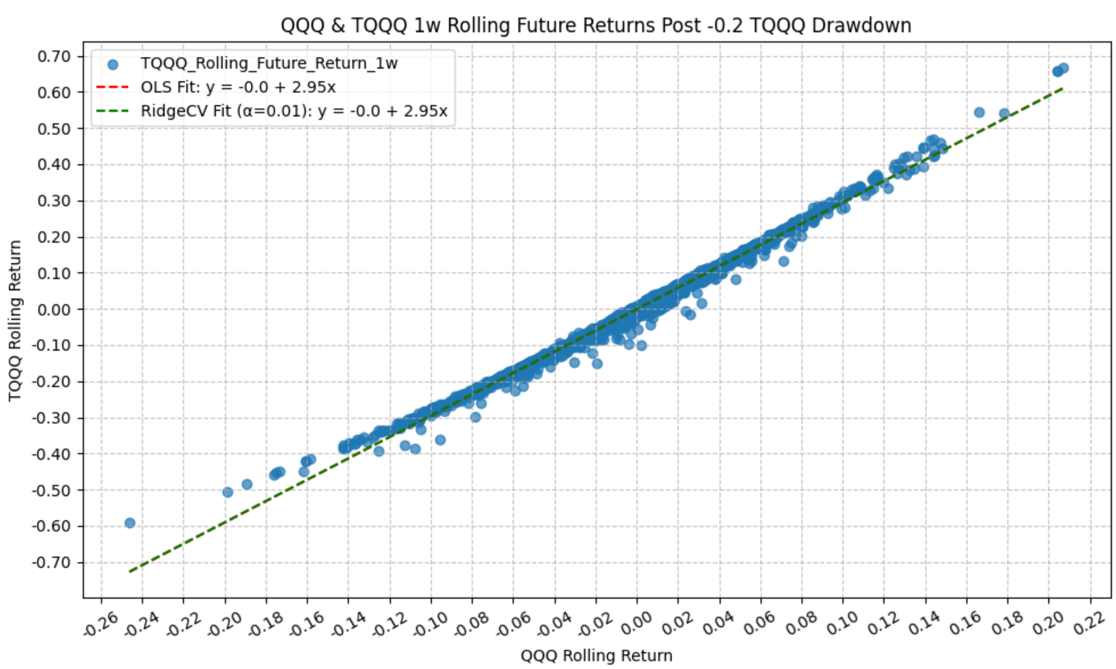





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1d   R-squared:
```

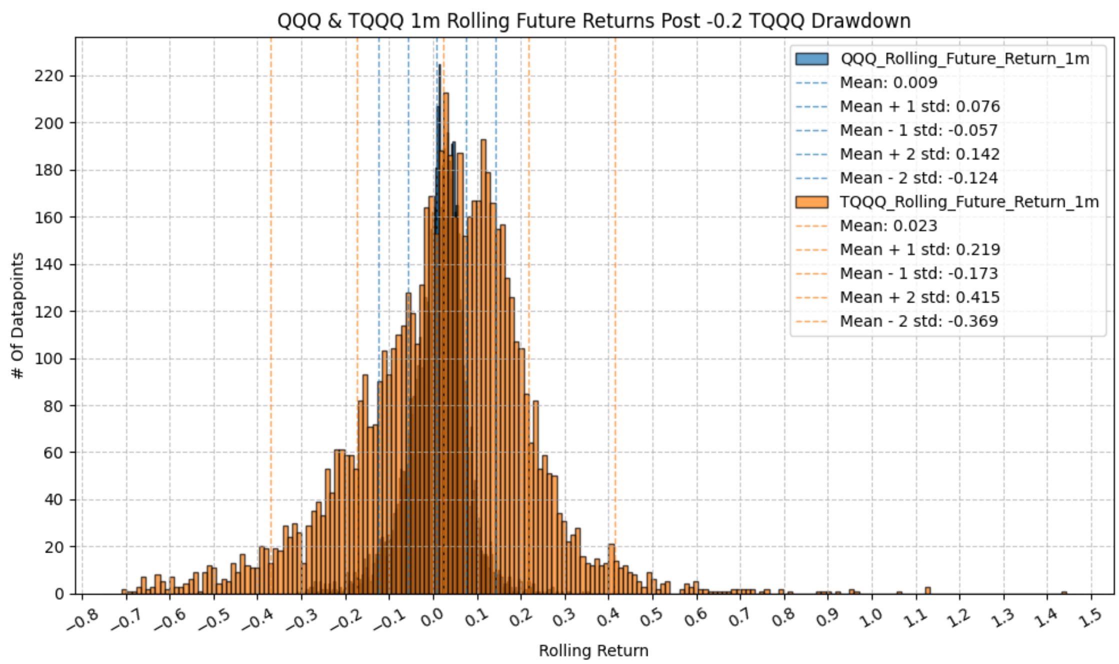
```
0.999
Model:                                    OLS   Adj. R-squared:
0.999
Method:                         Least Squares   F-statistic:
6.602e+06
Date:                        Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                14:26:27   Log-Likelihood:
33115.
No. Observations:                        6571   AIC:
-6.623e+04
Df Residuals:                            6569   BIC:
-6.621e+04
Df Model:                                   1
Covariance Type:                    nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                      -5.264e-05   1.93e-05     -2.721      0.007
-9.06e-05   -1.47e-05
QQQ_Rolling_Future_Return_1d     2.9551      0.001   2569.475      0.000
2.953       2.957
==============================================================================
Omnibus:                     9769.052   Durbin-Watson:                   2.565
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         39689255.457
Skew:                          -8.139   Prob(JB):                         0.00
Kurtosis:                     383.390   Cond. No.                         59.5
==============================================================================

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

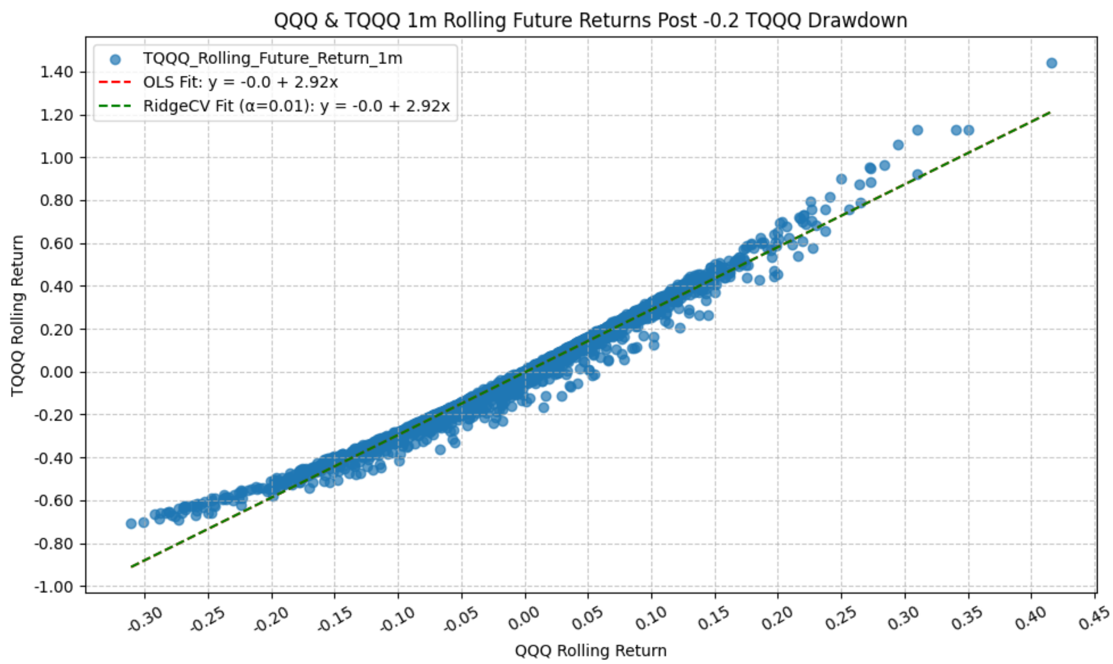





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1w   R-squared:
```

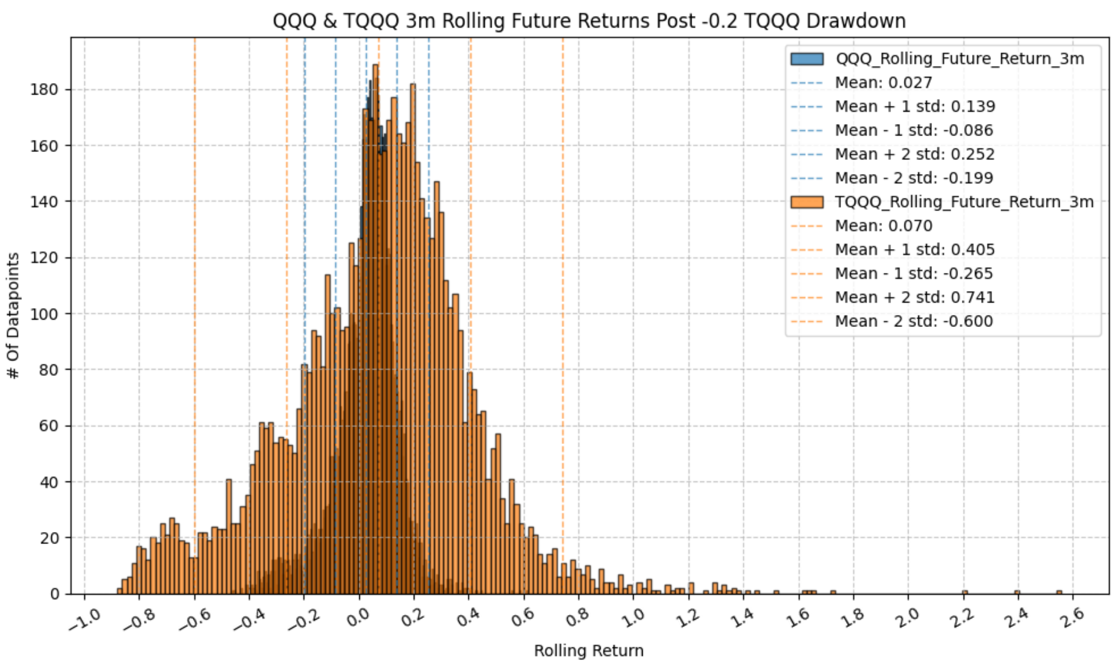
```
0.994
Model:                            OLS   Adj. R-squared:
0.994
Method:                 Least Squares   F-statistic:
1.069e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:28   Log-Likelihood:
22453.
No. Observations:                6567   AIC:
-4.490e+04
Df Residuals:                    6565   BIC:
-4.489e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0008    9.8e-05     -8.016      0.000
-0.001      -0.001
QQQ_Rolling_Future_Return_1w    2.9517      0.003   1033.957      0.000
2.946       2.957
==============================================================================
Omnibus:                     2705.152   Durbin-Watson:                   0.933
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           594917.588
Skew:                          -0.803   Prob(JB):                         0.00
Kurtosis:                      49.601   Cond. No.                         29.2
==============================================================================

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

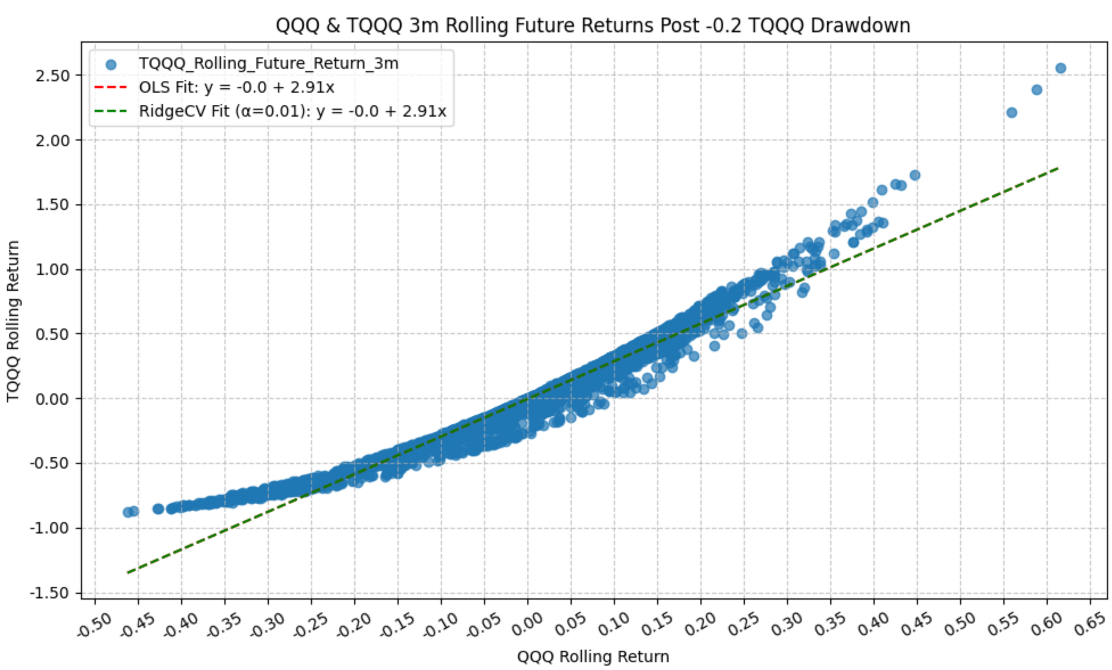





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1m   R-squared:
```

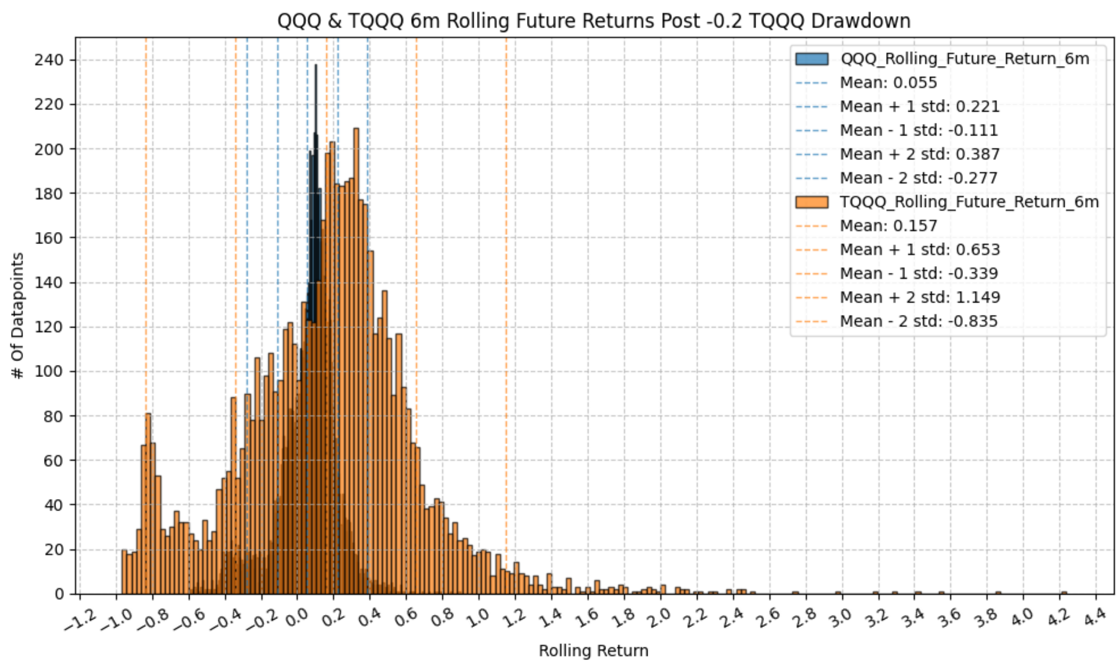
```
0.983
Model:                            OLS   Adj. R-squared:
0.983
Method:                 Least Squares   F-statistic:
3.703e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:29   Log-Likelihood:
14653.
No. Observations:                6551   AIC:
-2.930e+04
Df Residuals:                    6549   BIC:
-2.929e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0035      0.000    -10.801      0.000
-0.004      -0.003
QQQ_Rolling_Future_Return_1m    2.9224      0.005    608.511      0.000
2.913       2.932
==============================================================================
Omnibus:                     1535.850   Durbin-Watson:                   0.317
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            81019.960
Skew:                           0.160   Prob(JB):                         0.00
Kurtosis:                      20.226   Cond. No.                         15.0
==============================================================================

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

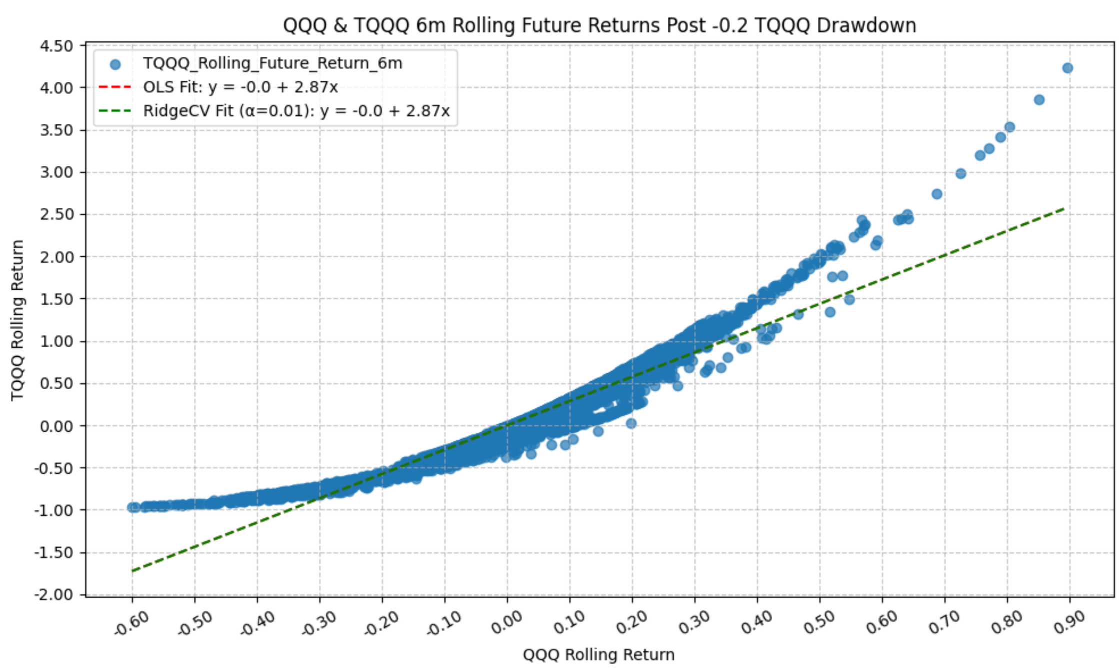





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3m   R-squared:
```

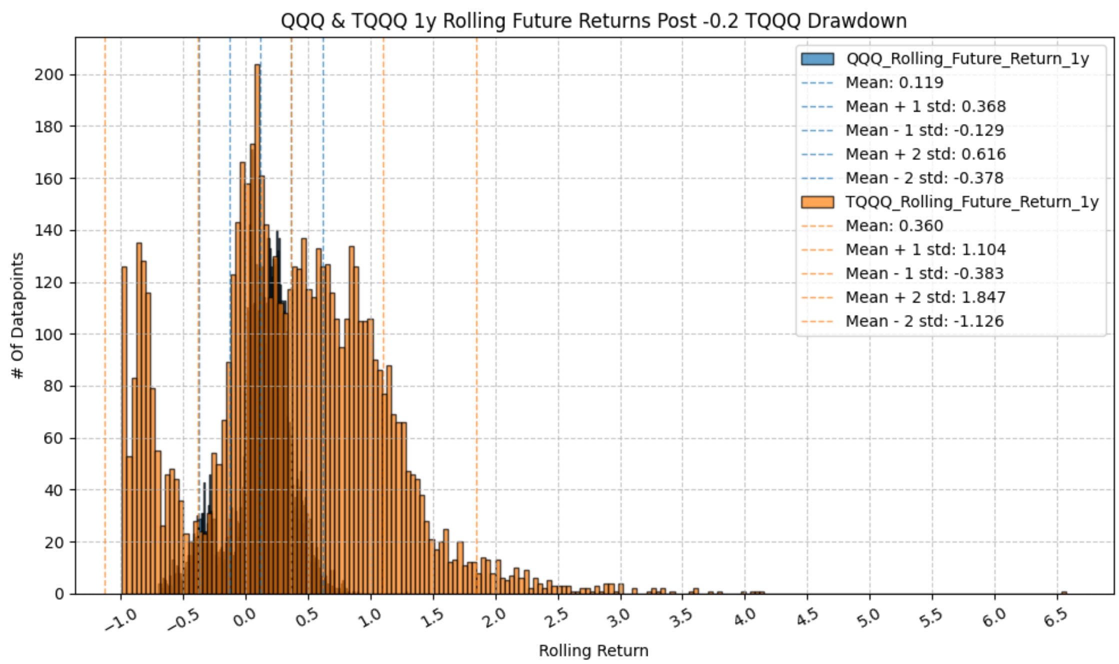
```
0.960
Model:                            OLS   Adj. R-squared:
0.960
Method:                 Least Squares   F-statistic:
1.544e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:30   Log-Likelihood:
8321.1
No. Observations:                6509   AIC:
-1.664e+04
Df Residuals:                    6507   BIC:
-1.662e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0070      0.001     -8.175      0.000
-0.009      -0.005
QQQ_Rolling_Future_Return_3m    2.9103      0.007    392.952      0.000
2.896       2.925
==============================================================================
Omnibus:                     2145.969   Durbin-Watson:                   0.136
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            38765.286
Skew:                           1.109   Prob(JB):                         0.00
Kurtosis:                      14.748   Cond. No.                         8.87
==============================================================================

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

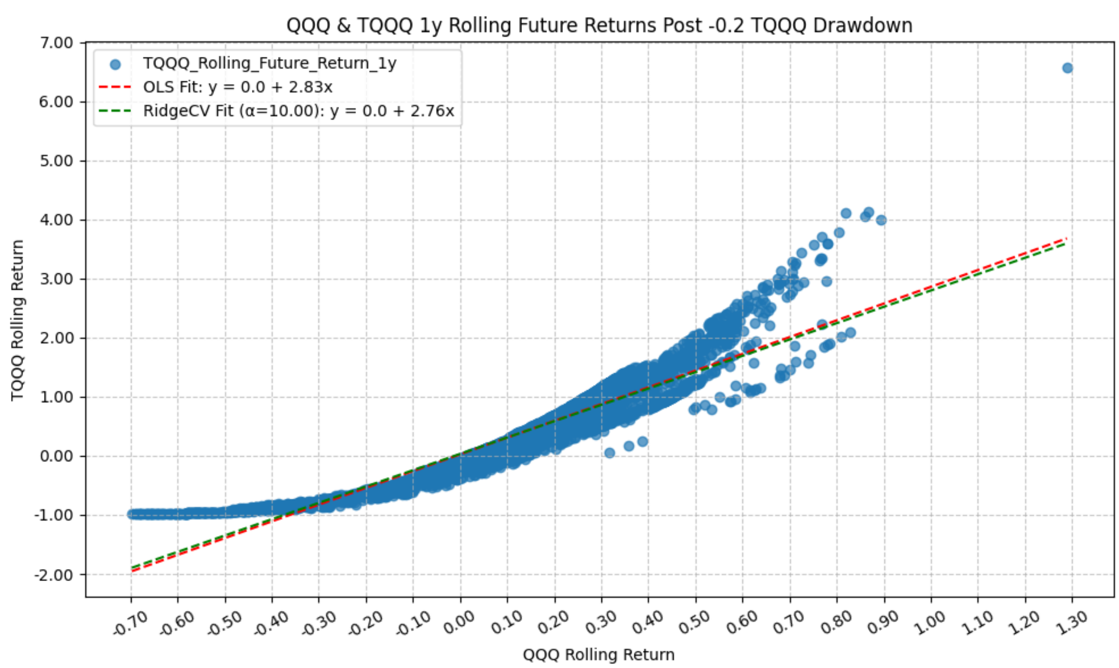





```
                              OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_6m   R-squared:
```

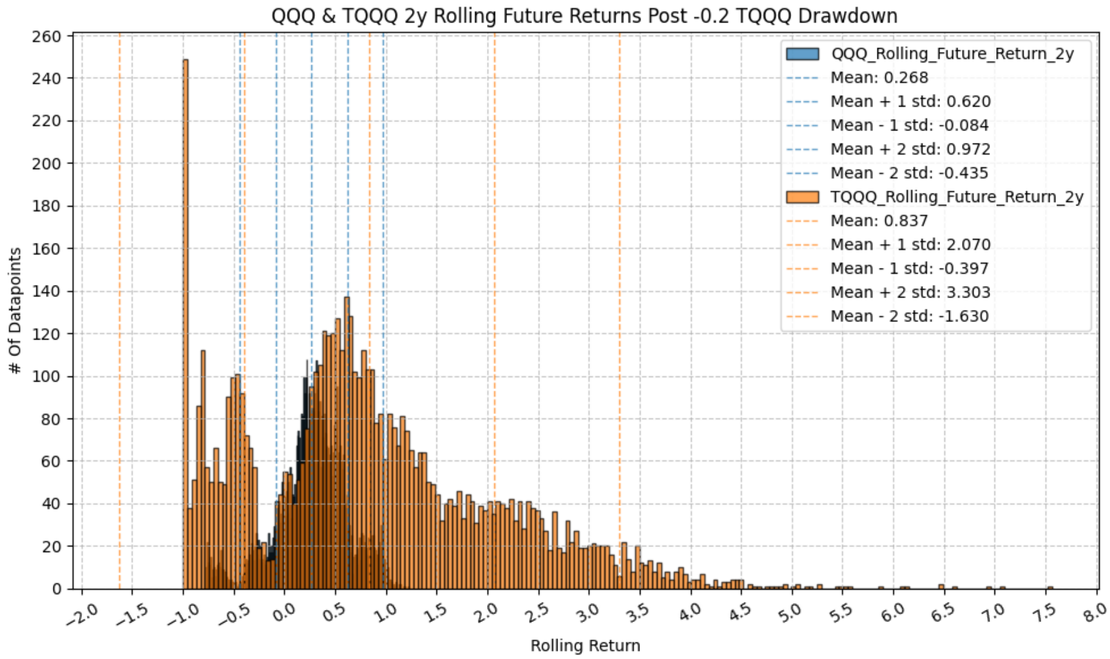
```
0.926
Model:                            OLS   Adj. R-squared:
0.926
Method:                 Least Squares   F-statistic:
8.102e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:32   Log-Likelihood:
3779.1
No. Observations:                6446   AIC:
-7554.
Df Residuals:                    6444   BIC:
-7541.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0015      0.002     -0.860      0.390
-0.005       0.002
QQQ_Rolling_Future_Return_6m   2.8743      0.010    284.646      0.000
2.855       2.894
==============================================================================
Omnibus:                     3183.205   Durbin-Watson:                   0.077
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            49759.451
Skew:                           1.977   Prob(JB):                         0.00
Kurtosis:                      16.024   Cond. No.                         6.04
==============================================================================

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

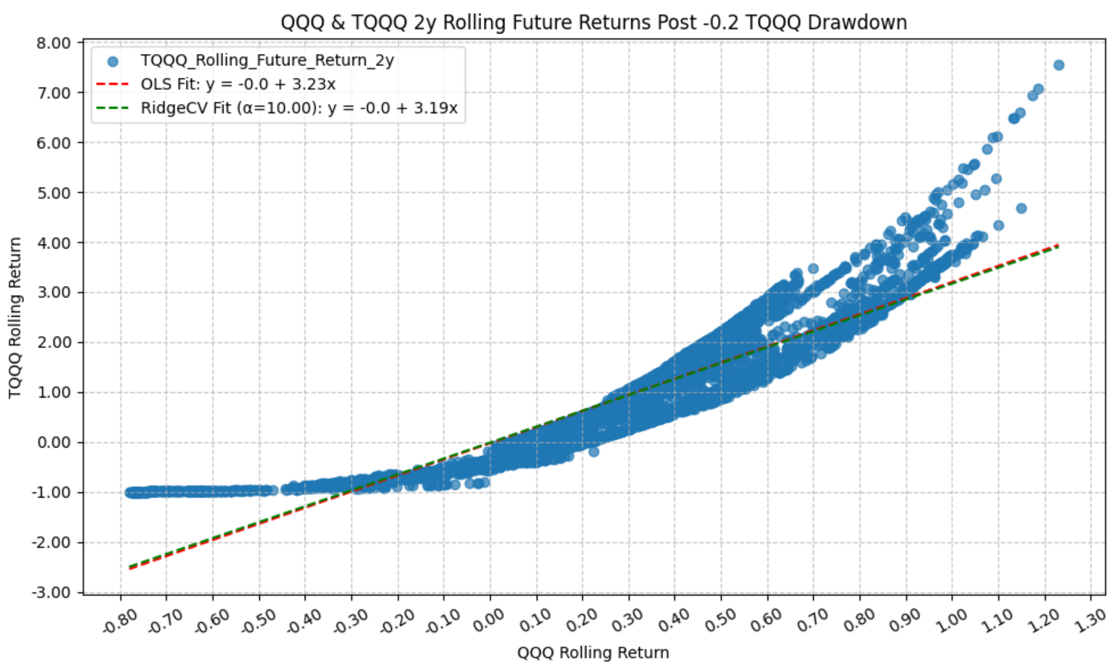





```
                              OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1y   R-squared:
```

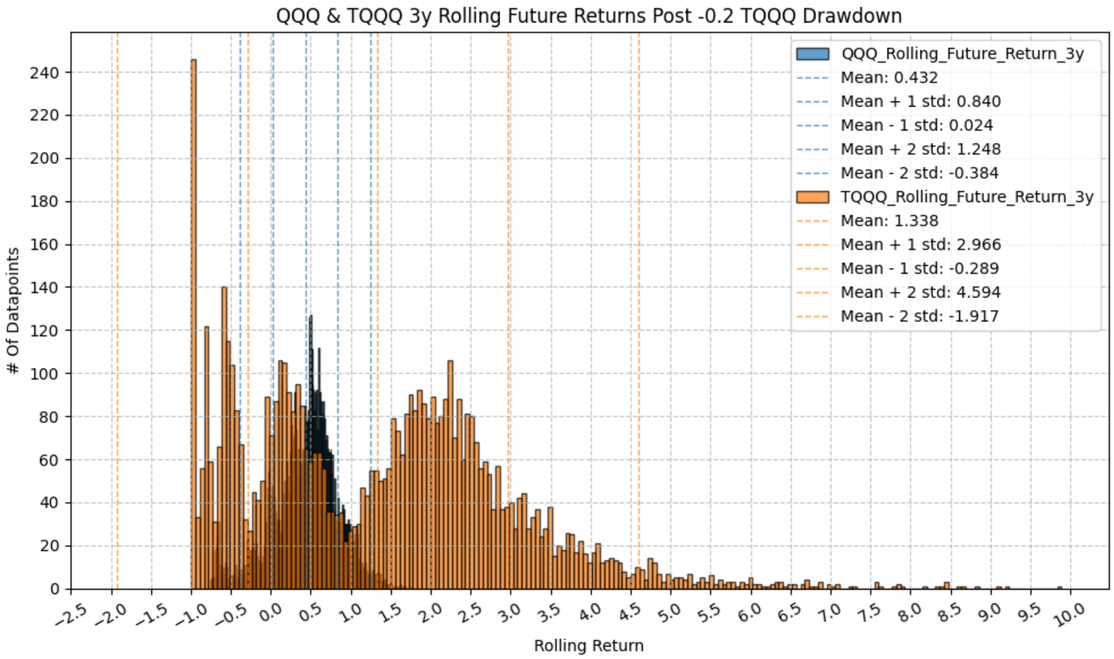
```
0.898
Model:                            OLS   Adj. R-squared:
0.898
Method:                 Least Squares   F-statistic:
5.551e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:33   Log-Likelihood:
115.86
No. Observations:                6320   AIC:
-227.7
Df Residuals:                    6318   BIC:
-214.2
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           0.0227      0.003      6.836      0.000
0.016       0.029
QQQ_Rolling_Future_Return_1y    2.8344      0.012    235.614      0.000
2.811       2.858
==============================================================================
Omnibus:                     2422.820   Durbin-Watson:                   0.068
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            19442.842
Skew:                           1.621   Prob(JB):                         0.00
Kurtosis:                      10.958   Cond. No.                         4.09
==============================================================================

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

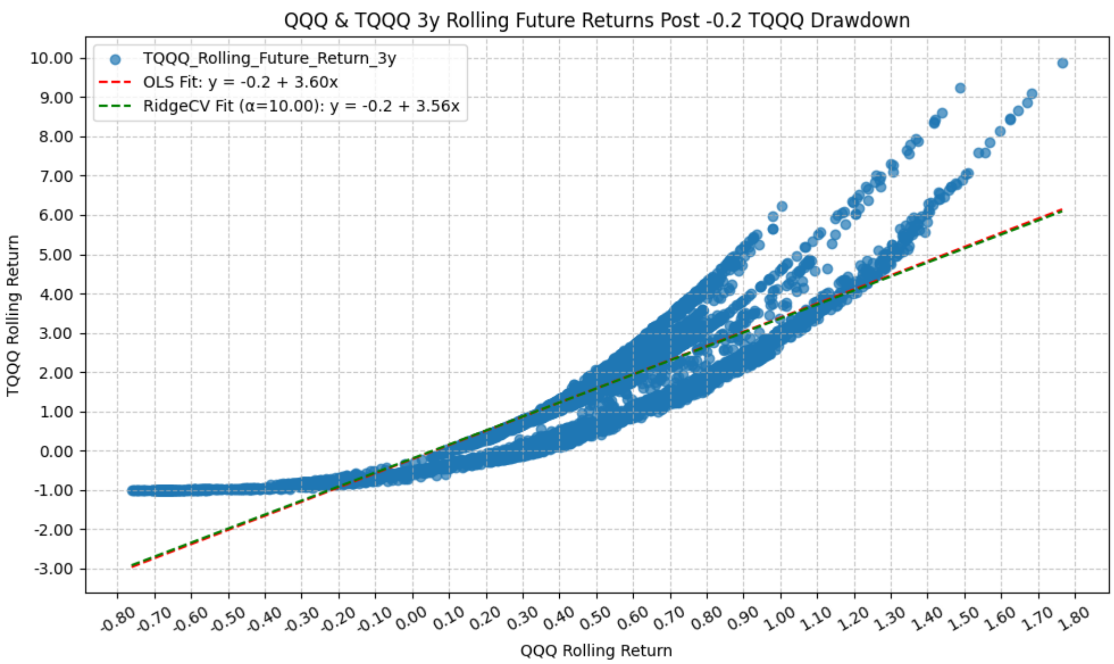





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_2y   R-squared:
```

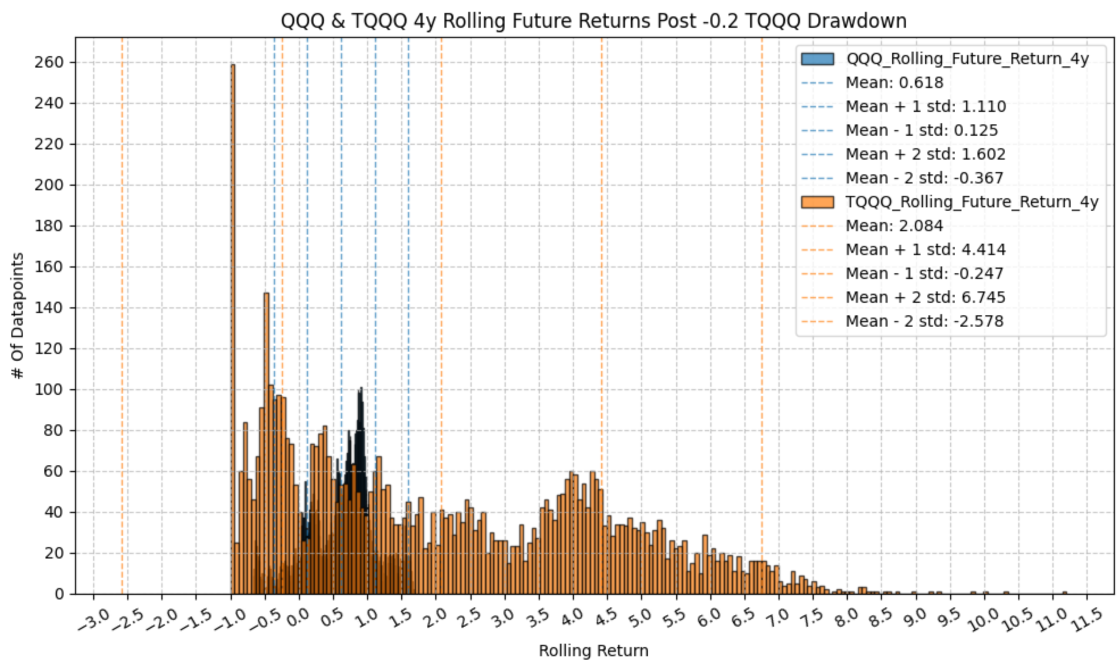
```
0.847
Model:                            OLS   Adj. R-squared:
0.847
Method:                 Least Squares   F-statistic:
3.365e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:34   Log-Likelihood:
-4181.2
No. Observations:                6068   AIC:
8366.
Df Residuals:                    6066   BIC:
8380.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0288      0.008     -3.698      0.000
-0.044      -0.014
QQQ_Rolling_Future_Return_2y   3.2276      0.018    183.436      0.000
3.193       3.262
==============================================================================
Omnibus:                     1695.729   Durbin-Watson:                   0.019
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4868.218
Skew:                           1.463   Prob(JB):                         0.00
Kurtosis:                       6.270   Cond. No.                         3.07
==============================================================================

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

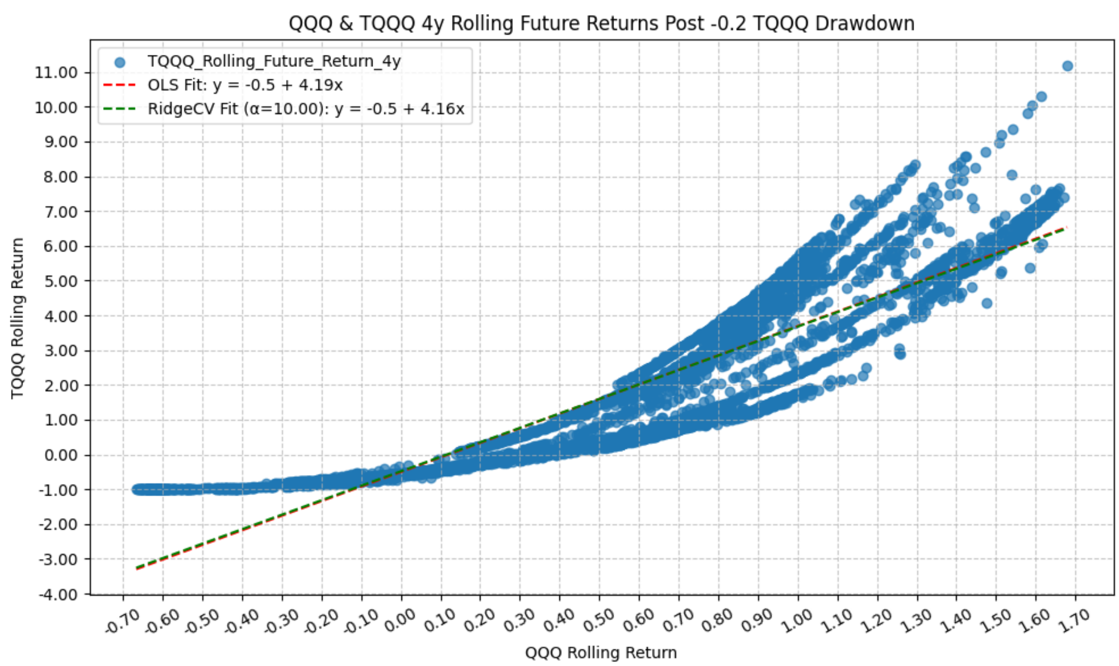





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_3y   R-squared:
```

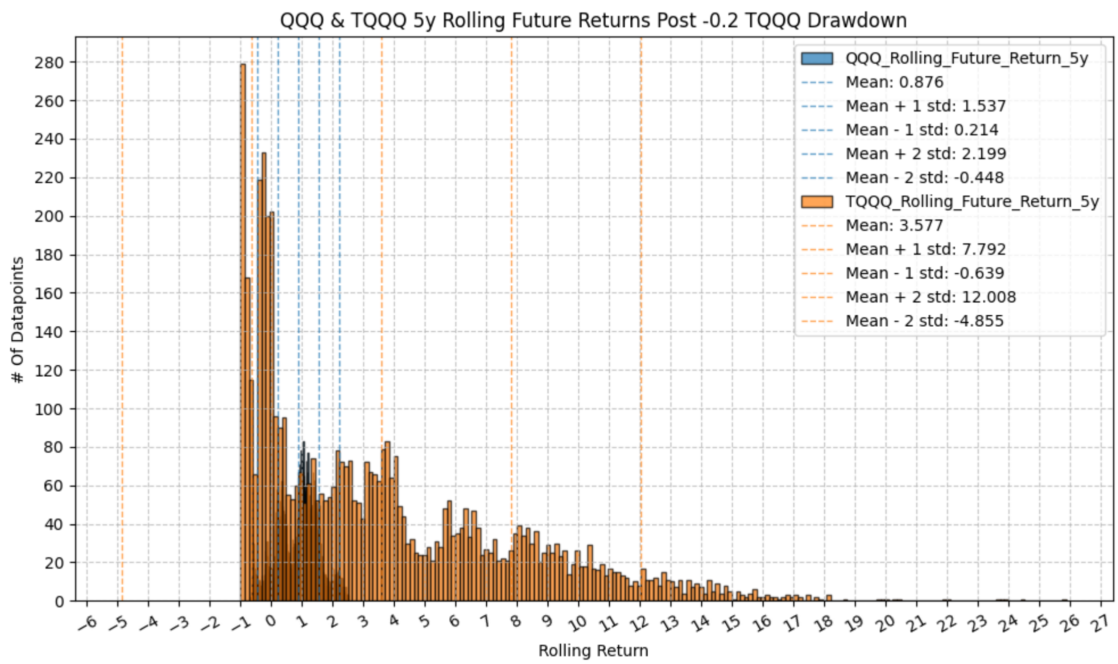
```
0.814
Model:                            OLS   Adj. R-squared:
0.814
Method:                 Least Squares   F-statistic:
2.547e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:35   Log-Likelihood:
-6191.6
No. Observations:                5816   AIC:
1.239e+04
Df Residuals:                    5814   BIC:
1.240e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.2170      0.013    -16.189      0.000
-0.243      -0.191
QQQ_Rolling_Future_Return_3y    3.6008      0.023    159.606      0.000
3.557       3.645
==============================================================================
Omnibus:                      874.268   Durbin-Watson:                   0.015
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1570.330
Skew:                           0.966   Prob(JB):                         0.00
Kurtosis:                       4.657   Cond. No.                         2.98
==============================================================================

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

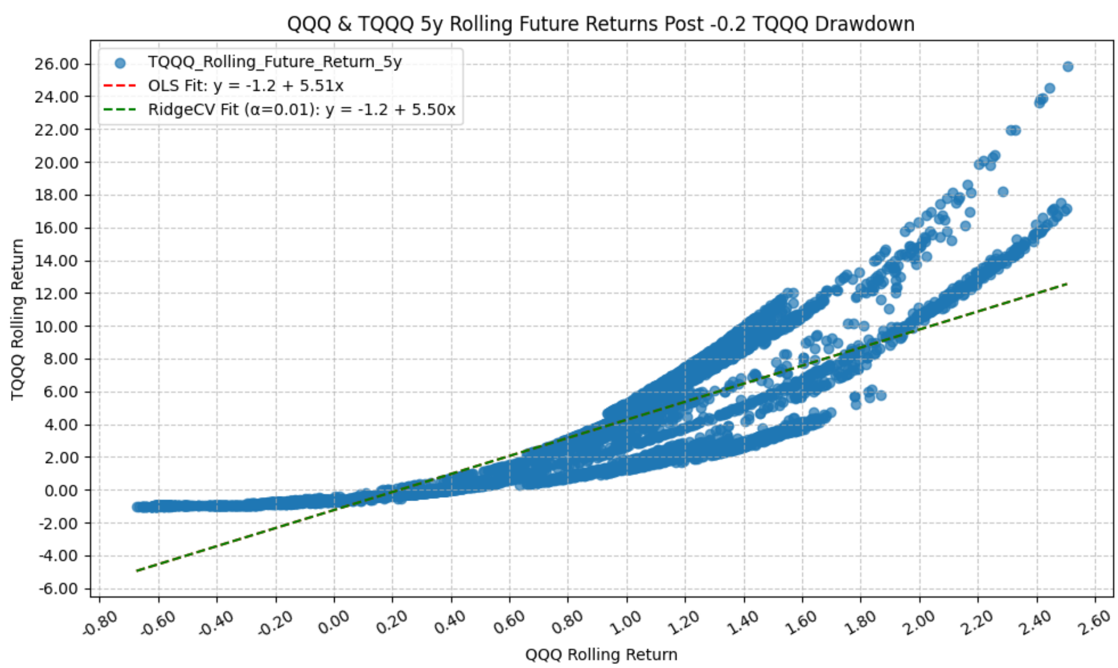





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_4y   R-squared:
```

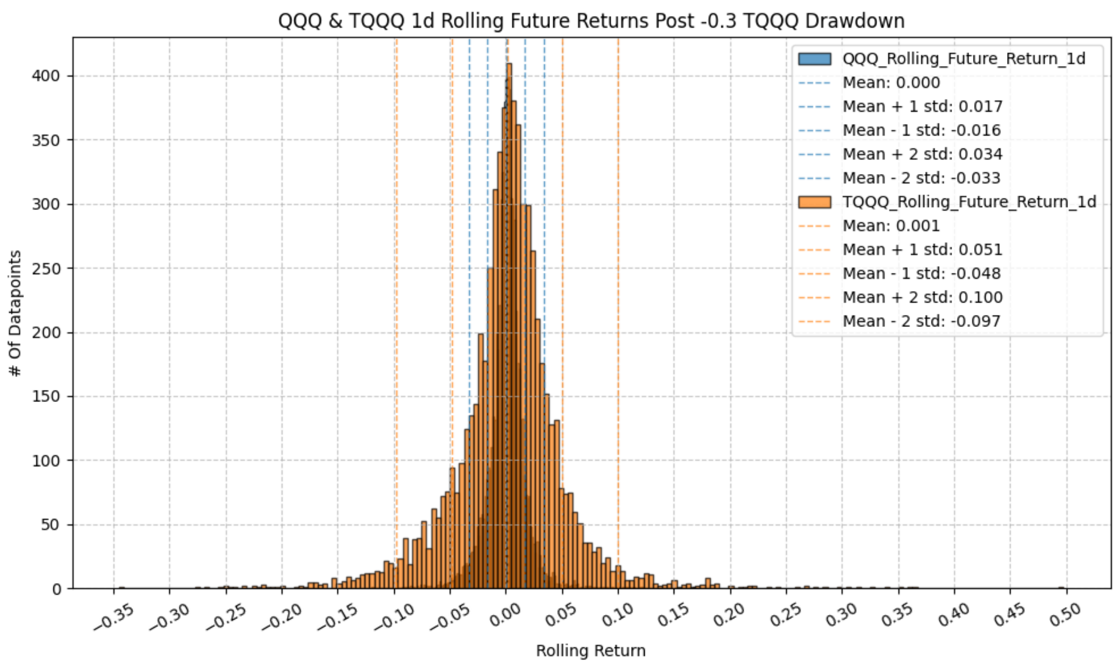
```
0.784
Model:                            OLS   Adj. R-squared:
0.784
Method:                 Least Squares   F-statistic:
2.024e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:36   Log-Likelihood:
-8333.7
No. Observations:                5564   AIC:
1.667e+04
Df Residuals:                    5562   BIC:
1.668e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.5059      0.023    -21.736      0.000
-0.552      -0.460
QQQ_Rolling_Future_Return_4y    4.1927      0.029    142.267      0.000
4.135       4.250
==============================================================================
Omnibus:                       89.406   Durbin-Watson:                   0.010
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               63.314
Skew:                           0.153   Prob(JB):                     1.78e-14
Kurtosis:                       2.576   Cond. No.                         2.96
==============================================================================

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

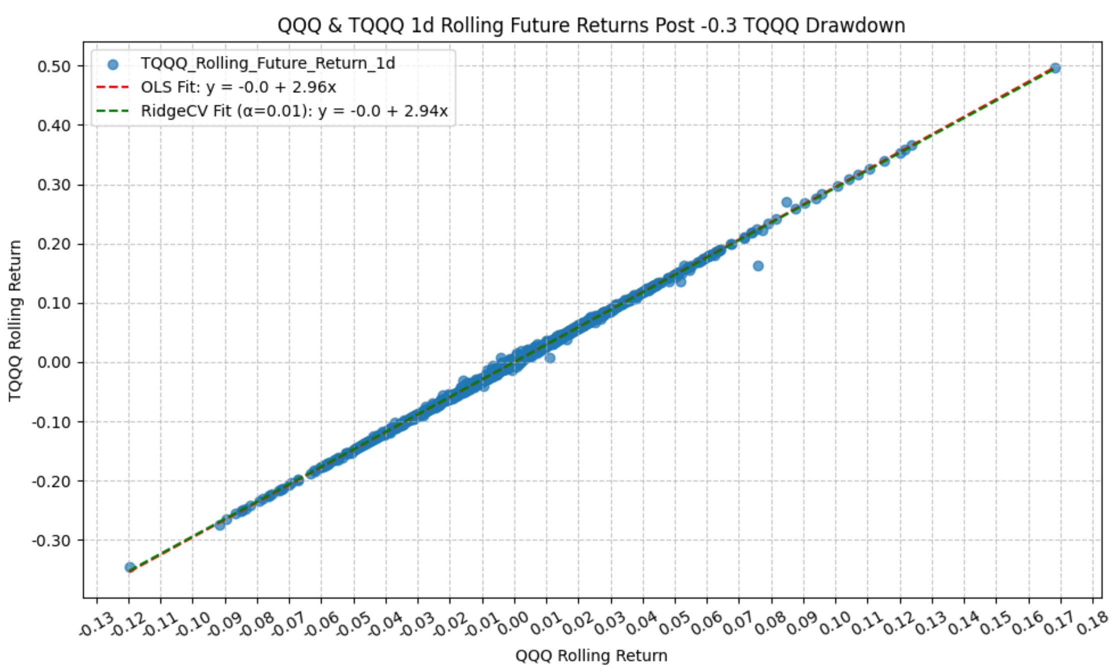





```
                             OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_5y   R-squared:
```

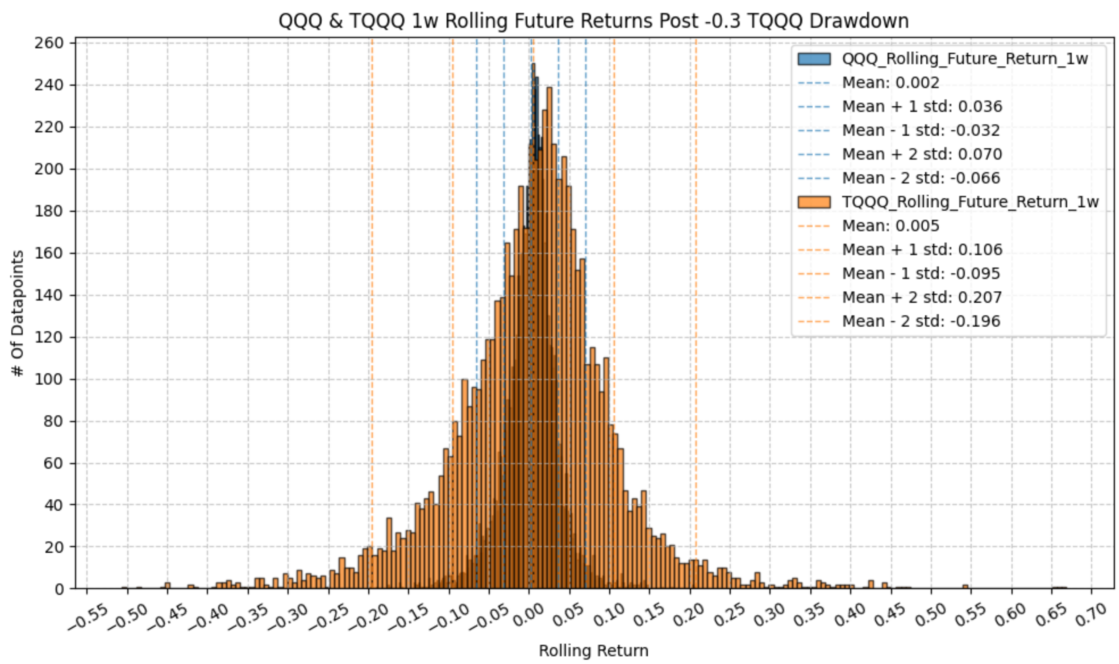
```
0.747
Model:                                      OLS   Adj. R-squared:
0.747
Method:                           Least Squares   F-statistic:
1.566e+04
Date:                          Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                  14:26:37   Log-Likelihood:
-11532.
No. Observations:                          5312   AIC:
2.307e+04
Df Residuals:                              5310   BIC:
2.308e+04
Df Model:                                     1
Covariance Type:                      nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -1.2438      0.048    -25.759      0.000
-1.338      -1.149
QQQ_Rolling_Future_Return_5y    5.5050      0.044    125.134      0.000
5.419       5.591
==============================================================================
Omnibus:                      256.613   Durbin-Watson:                   0.009
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              381.078
Skew:                           0.437   Prob(JB):                     1.78e-83
Kurtosis:                       3.979   Cond. No.                         3.00
==============================================================================

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

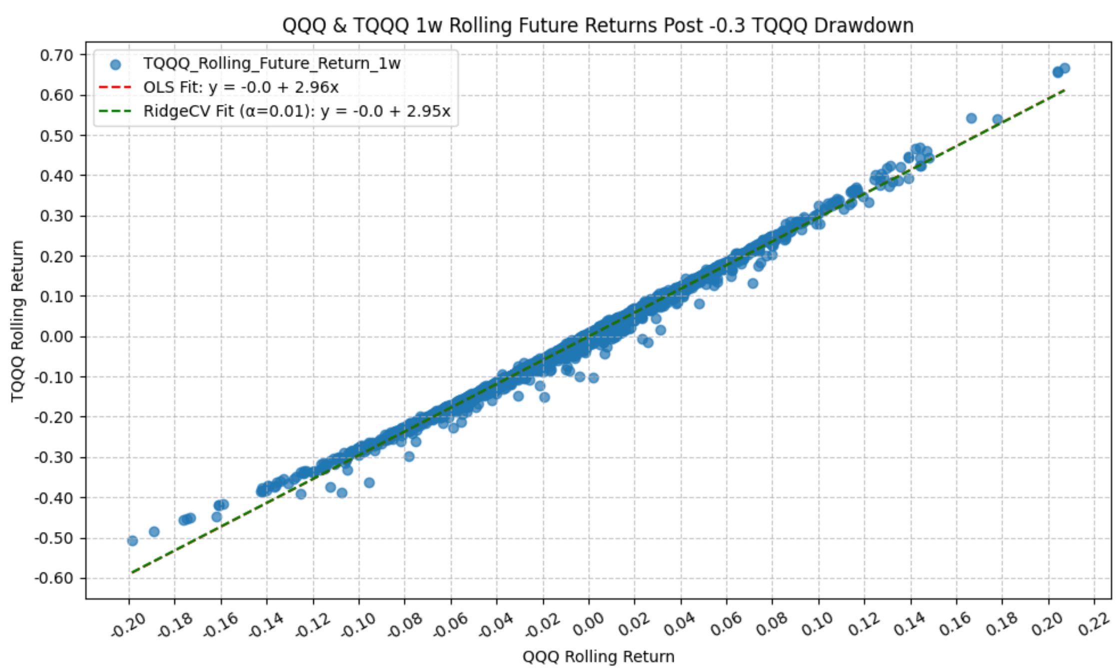





```
                                  OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_1d   R-squared:
```

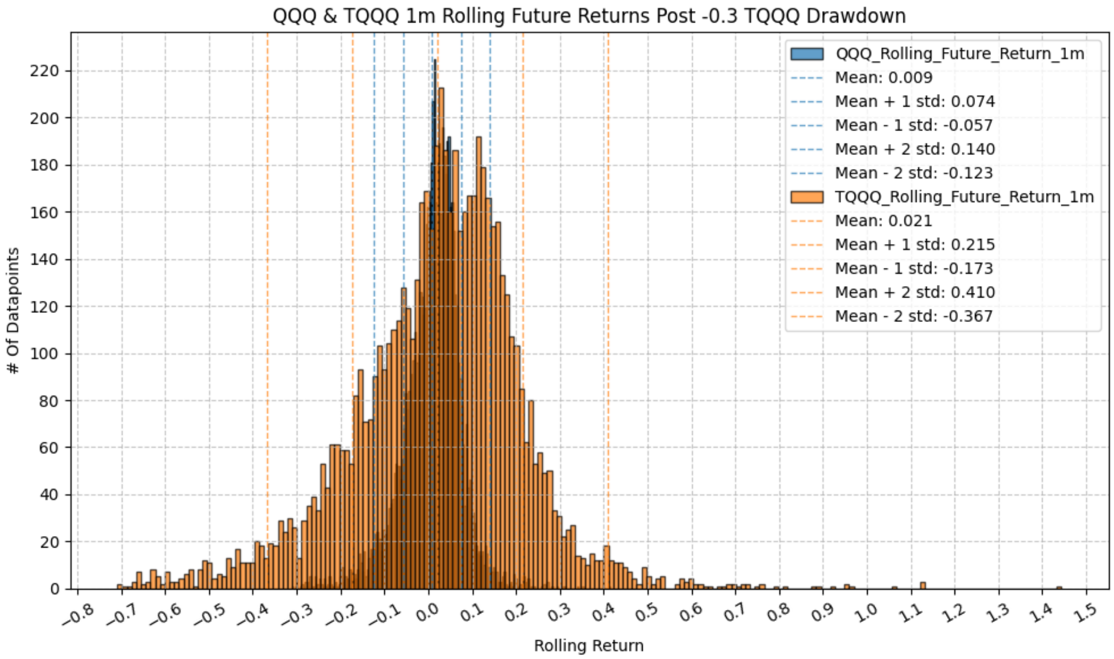
```
0.999
Model:                            OLS   Adj. R-squared:
0.999
Method:                 Least Squares   F-statistic:
6.433e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:39   Log-Likelihood:
32894.
No. Observations:                6531   AIC:
-6.578e+04
Df Residuals:                    6529   BIC:
-6.577e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                        -5.296e-05   1.95e-05     -2.721      0.007
-9.11e-05   -1.48e-05
QQQ_Rolling_Future_Return_1d     2.9551      0.001   2536.404      0.000
2.953       2.957
==============================================================================
Omnibus:                     9694.083   Durbin-Watson:                   2.565
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         38964571.195
Skew:                          -8.113   Prob(JB):                         0.00
Kurtosis:                     381.052   Cond. No.                         59.9
==============================================================================

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

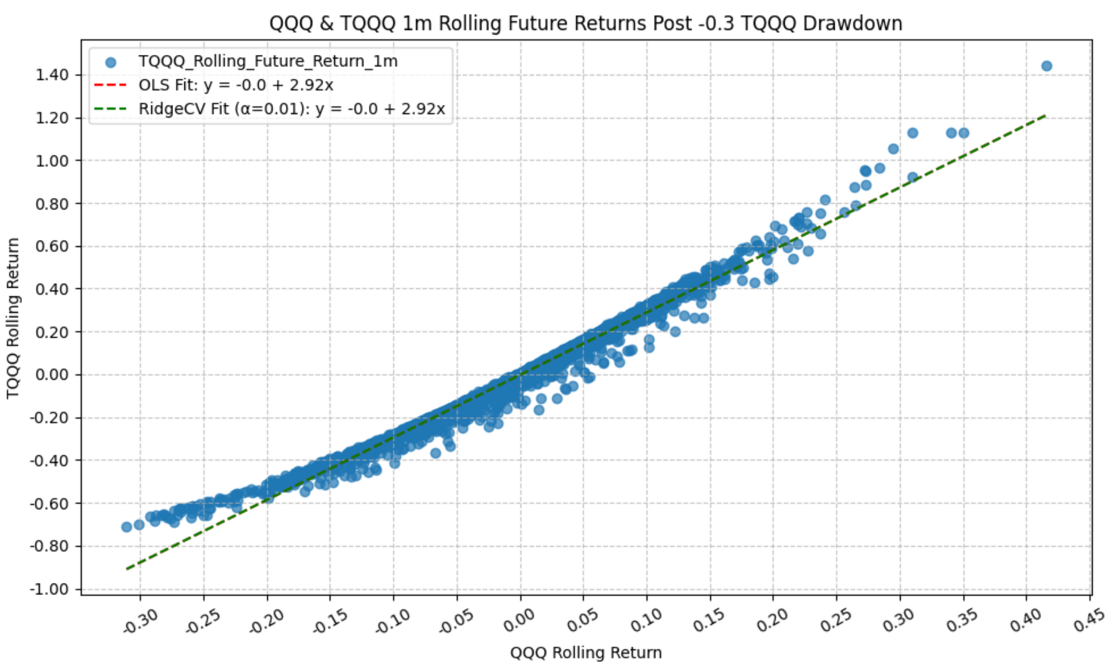





```
                               OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_1w   R-squared:
```

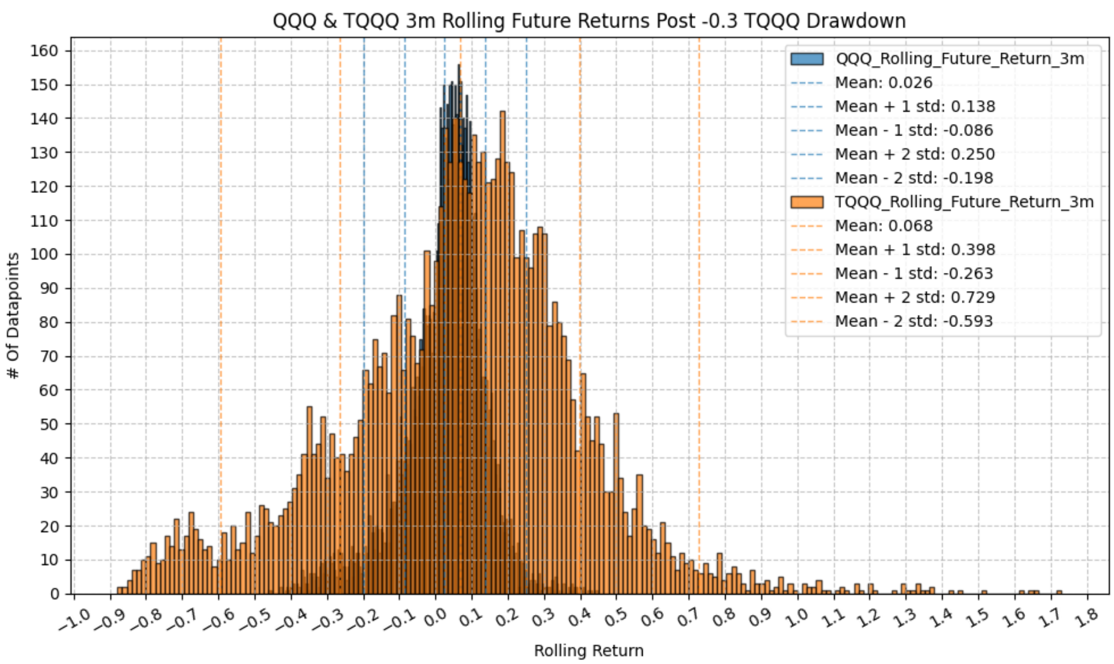
```
0.994
Model:                            OLS   Adj. R-squared:
0.994
Method:                 Least Squares   F-statistic:
1.119e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:40   Log-Likelihood:
22520.
No. Observations:                6527   AIC:
-4.504e+04
Df Residuals:                    6525   BIC:
-4.502e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0008   9.53e-05     -8.333      0.000
-0.001      -0.001
QQQ_Rolling_Future_Return_1w    2.9552      0.003   1057.792      0.000
2.950       2.961
==============================================================================
Omnibus:                     3463.566   Durbin-Watson:                   0.902
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           388402.497
Skew:                          -1.580   Prob(JB):                         0.00
Kurtosis:                      40.659   Cond. No.                         29.4
==============================================================================

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

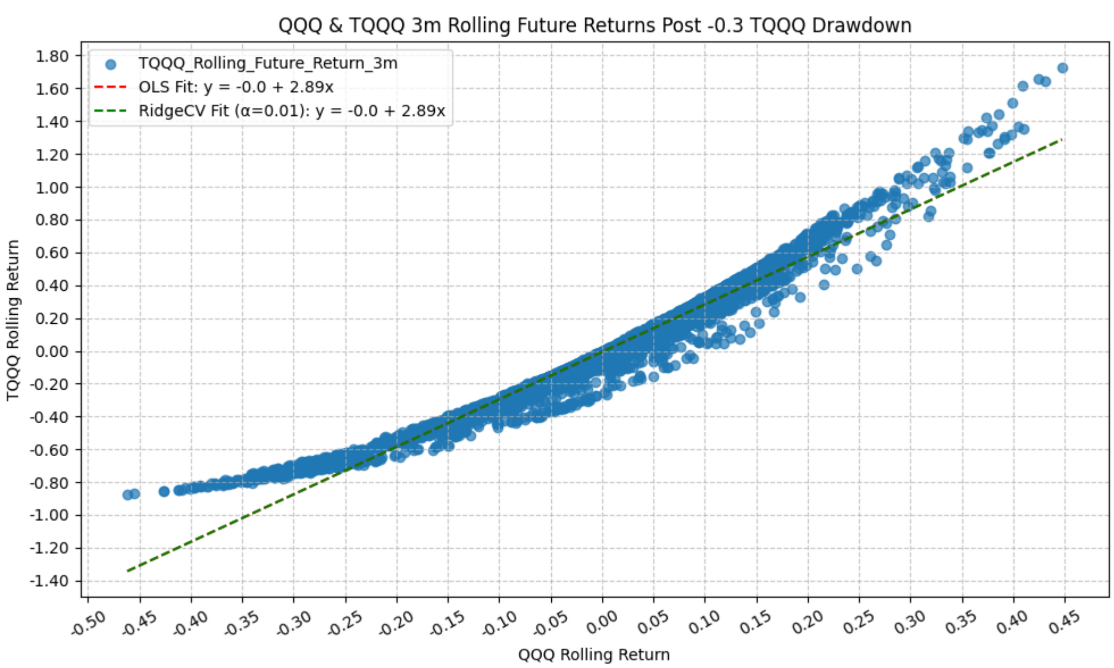





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_1m   R-squared:
```

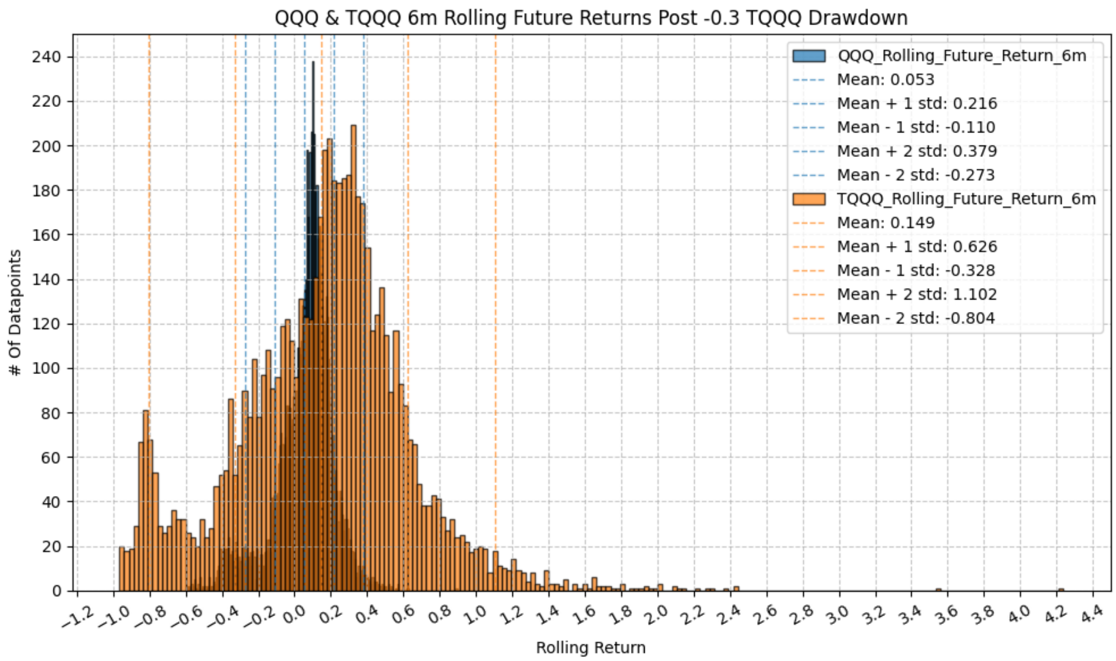
```
0.983
Model:                            OLS   Adj. R-squared:
0.983
Method:                 Least Squares   F-statistic:
3.675e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:41   Log-Likelihood:
14623.
No. Observations:                6511   AIC:
-2.924e+04
Df Residuals:                    6509   BIC:
-2.923e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0035      0.000    -11.033      0.000
-0.004      -0.003
QQQ_Rolling_Future_Return_1m    2.9176      0.005    606.191      0.000
2.908       2.927
==============================================================================
Omnibus:                     1511.925   Durbin-Watson:                   0.308
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            81855.191
Skew:                           0.083   Prob(JB):                         0.00
Kurtosis:                      20.369   Cond. No.                         15.2
==============================================================================

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

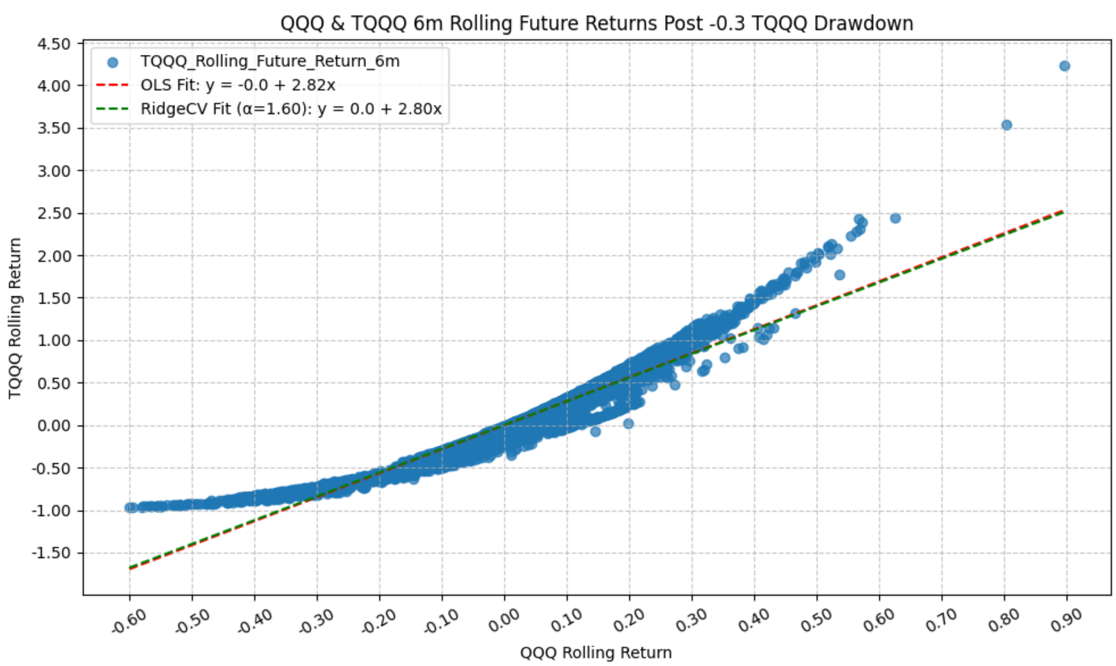





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3m   R-squared:
```

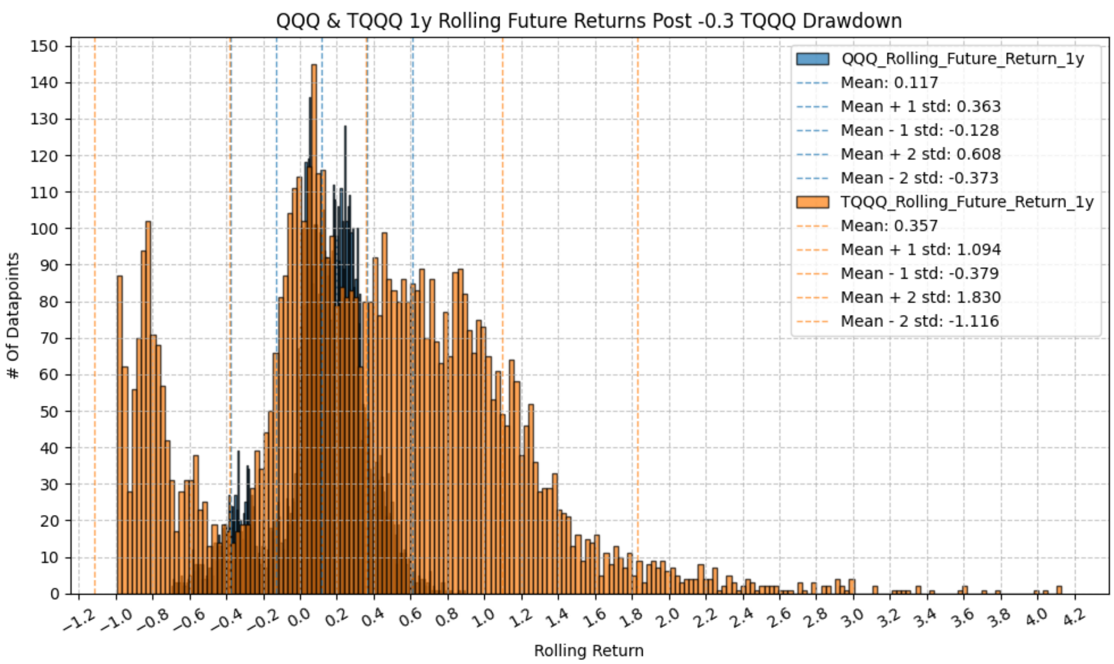
```
0.961
Model:                            OLS   Adj. R-squared:
0.961
Method:                 Least Squares   F-statistic:
1.585e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:42   Log-Likelihood:
8457.5
No. Observations:                6469   AIC:
-1.691e+04
Df Residuals:                    6467   BIC:
-1.690e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0067      0.001     -8.040      0.000
-0.008      -0.005
QQQ_Rolling_Future_Return_3m    2.8943      0.007    398.066      0.000
2.880       2.909
==============================================================================
Omnibus:                     1346.125   Durbin-Watson:                   0.103
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            15267.066
Skew:                           0.666   Prob(JB):                         0.00
Kurtosis:                      10.407   Cond. No.                         8.94
==============================================================================

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

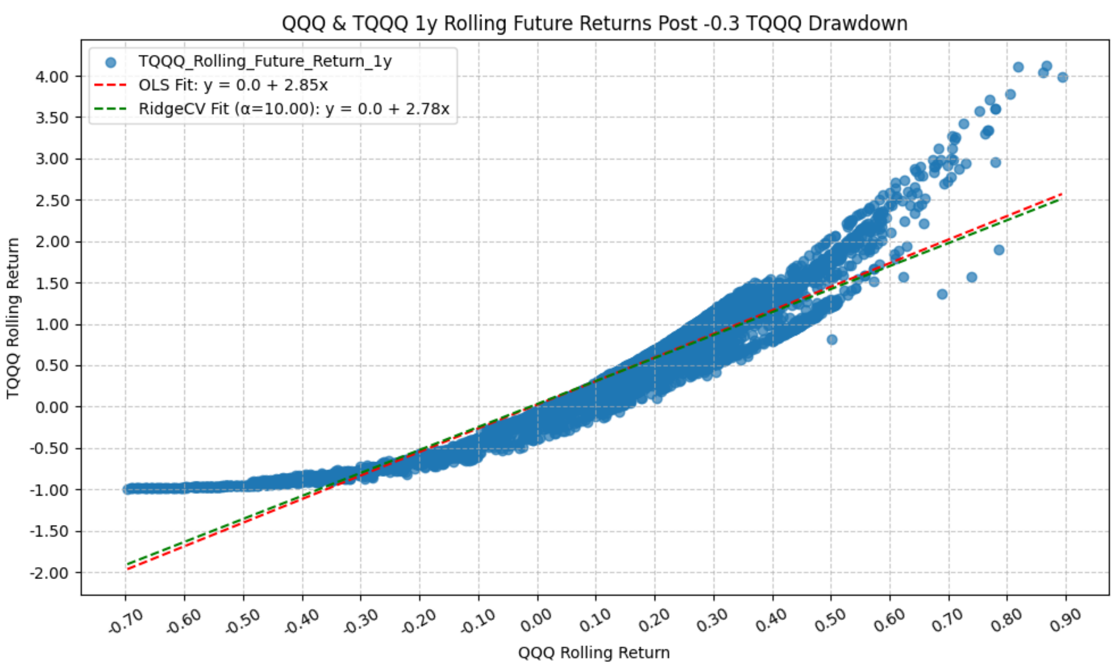





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_6m   R-squared:
```

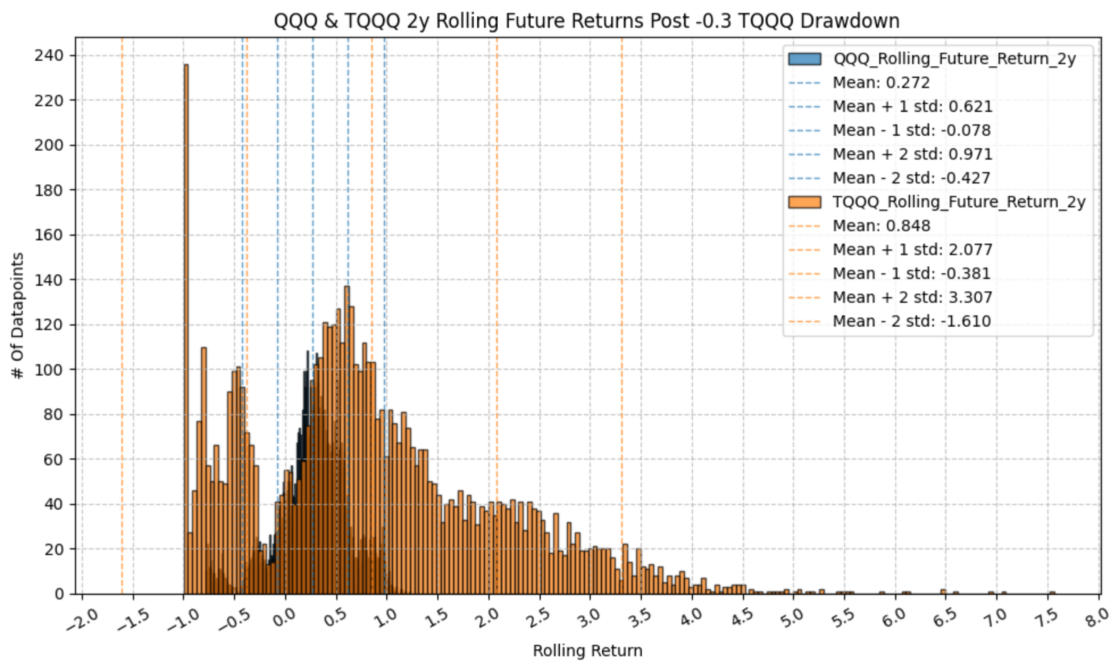
```
0.929
Model:                            OLS   Adj. R-squared:
0.929
Method:                 Least Squares   F-statistic:
8.378e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:43   Log-Likelihood:
4128.3
No. Observations:                6406   AIC:
-8253.
Df Residuals:                    6404   BIC:
-8239.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0006      0.002     -0.337      0.736
-0.004       0.003
QQQ_Rolling_Future_Return_6m    2.8222      0.010    289.447      0.000
2.803       2.841
==============================================================================
Omnibus:                     2682.468   Durbin-Watson:                   0.109
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            36485.982
Skew:                           1.629   Prob(JB):                         0.00
Kurtosis:                      14.228   Cond. No.                         6.16
==============================================================================

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

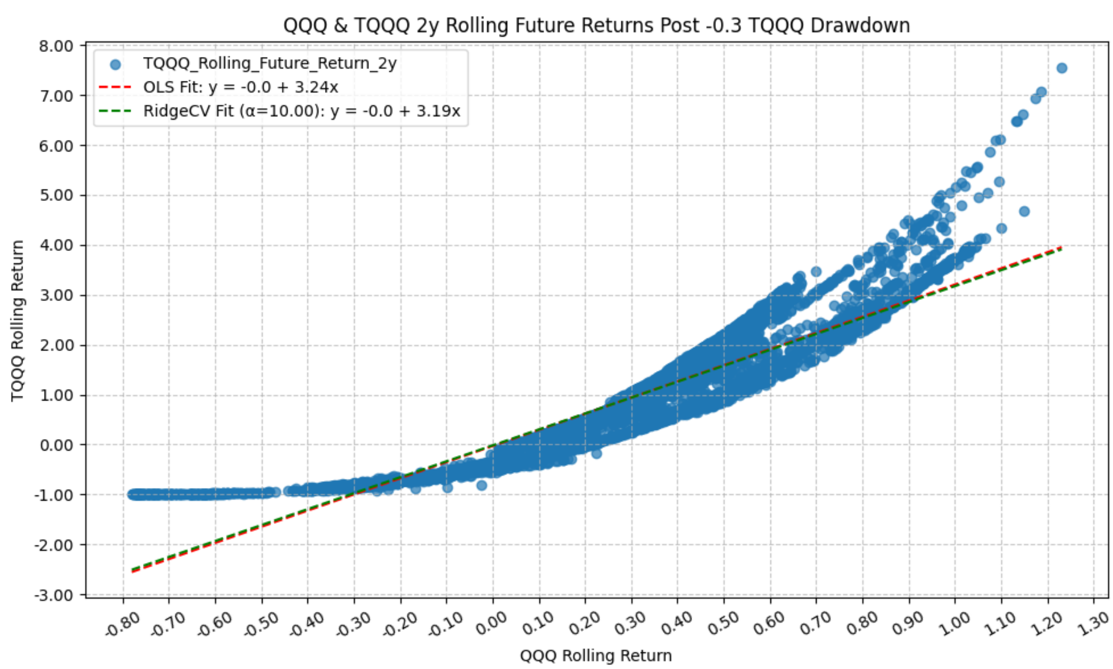





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1y   R-squared:
```

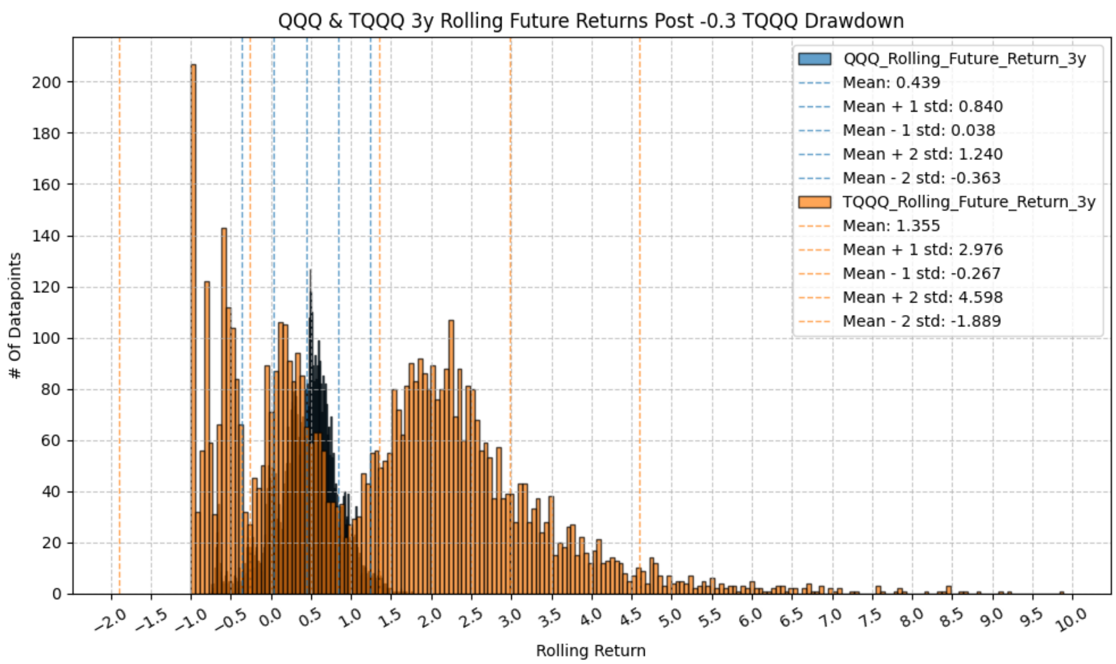
```
0.902
Model:                                 OLS   Adj. R-squared:
0.902
Method:                      Least Squares   F-statistic:
5.754e+04
Date:                     Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                             14:26:45   Log-Likelihood:
291.84
No. Observations:                     6280   AIC:
-579.7
Df Residuals:                         6278   BIC:
-566.2
Df Model:                                1
Covariance Type:                 nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           0.0224      0.003      6.919      0.000
0.016       0.029
QQQ_Rolling_Future_Return_1y    2.8516      0.012    239.879      0.000
2.828       2.875
==============================================================================
Omnibus:                     1986.661   Durbin-Watson:                   0.043
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8583.652
Skew:                           1.493   Prob(JB):                         0.00
Kurtosis:                       7.887   Cond. No.                         4.14
==============================================================================

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

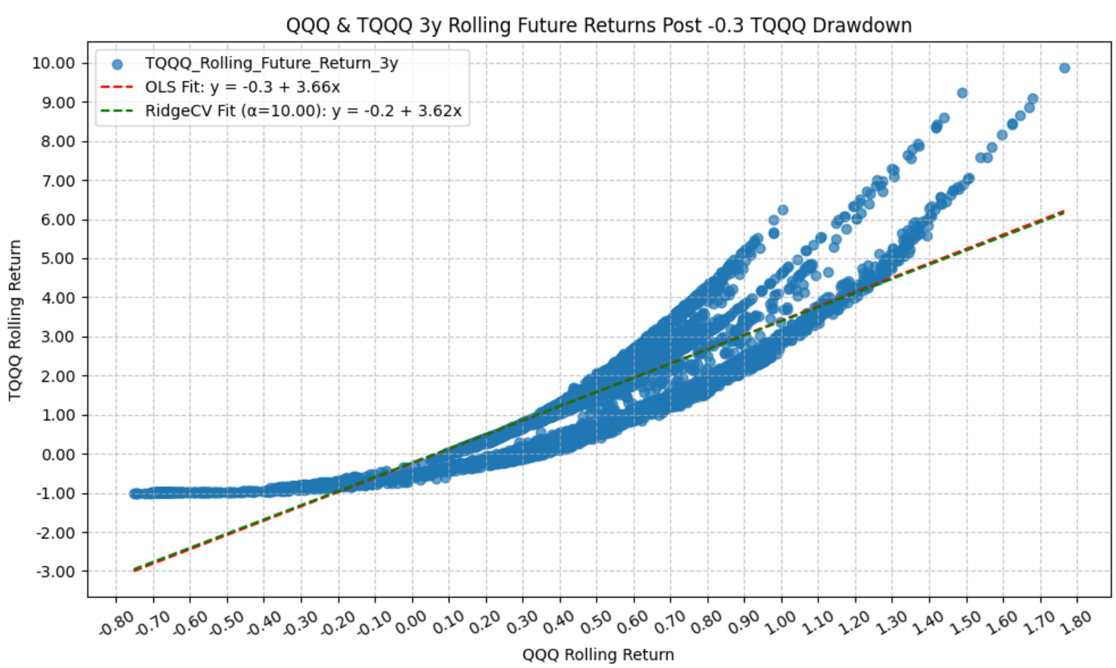





```
                                  OLS Regression Results
================================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_2y   R-squared:
```

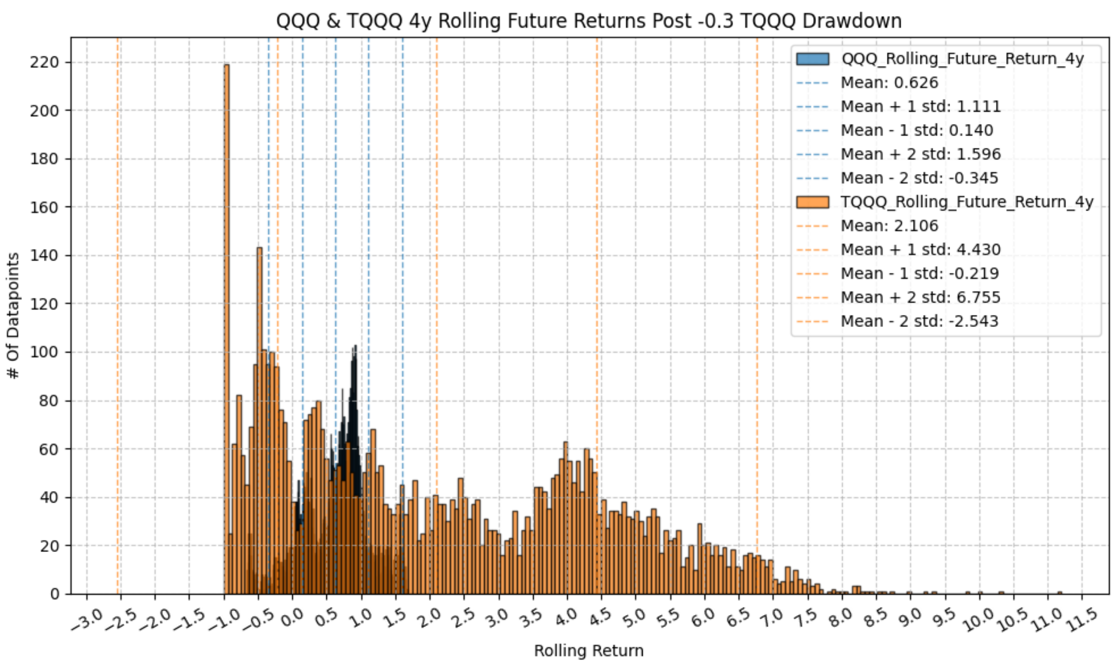
```
0.847
Model:                                 OLS   Adj. R-squared:
0.847
Method:                      Least Squares   F-statistic:
3.331e+04
Date:                     Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                             14:26:46   Log-Likelihood:
-4141.4
No. Observations:                     6028   AIC:
8287.
Df Residuals:                         6026   BIC:
8300.
Df Model:                                1
Covariance Type:                 nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0317      0.008     -4.039      0.000
-0.047      -0.016
QQQ_Rolling_Future_Return_2y     3.2366      0.018    182.524      0.000
3.202       3.271
==============================================================================
Omnibus:                     1703.262   Durbin-Watson:                   0.019
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4959.569
Skew:                           1.473   Prob(JB):                         0.00
Kurtosis:                       6.326   Cond. No.                         3.10
==============================================================================

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

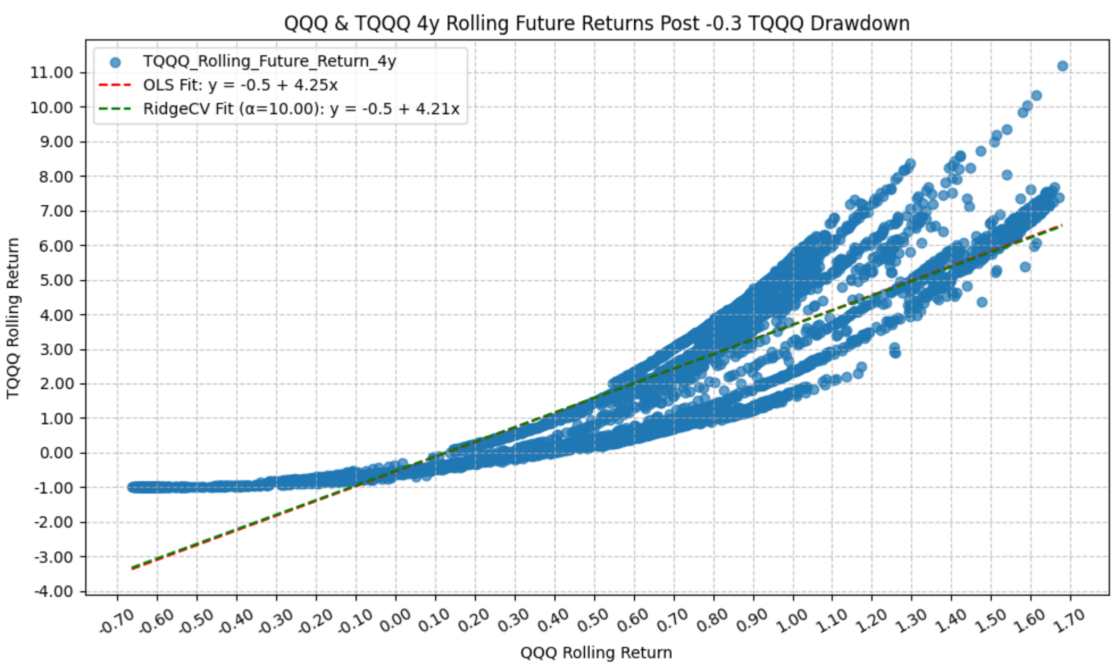





```
                           OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3y   R-squared:
```

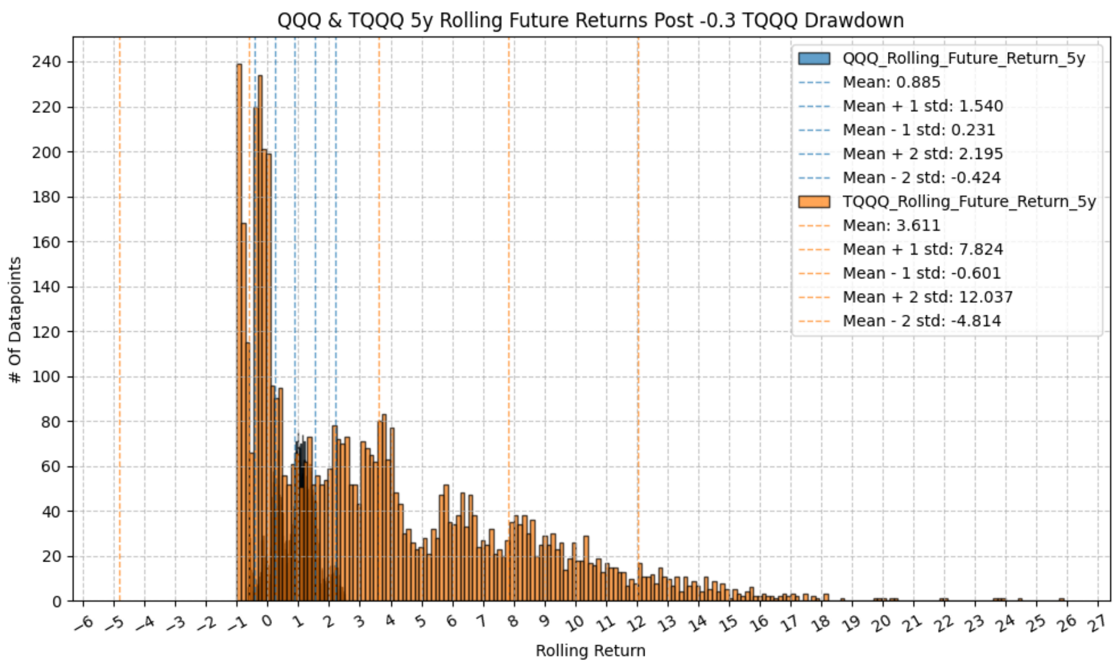
```
0.816
Model:                            OLS   Adj. R-squared:
0.816
Method:                 Least Squares   F-statistic:
2.566e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:47   Log-Likelihood:
-6094.3
No. Observations:                5776   AIC:
1.219e+04
Df Residuals:                    5774   BIC:
1.221e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.2502      0.014    -18.446      0.000
-0.277      -0.224
QQQ_Rolling_Future_Return_3y     3.6568      0.023    160.193      0.000
3.612       3.702
==============================================================================
Omnibus:                      876.215   Durbin-Watson:                   0.015
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1596.509
Skew:                           0.967   Prob(JB):                         0.00
Kurtosis:                       4.700   Cond. No.                         3.05
==============================================================================

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

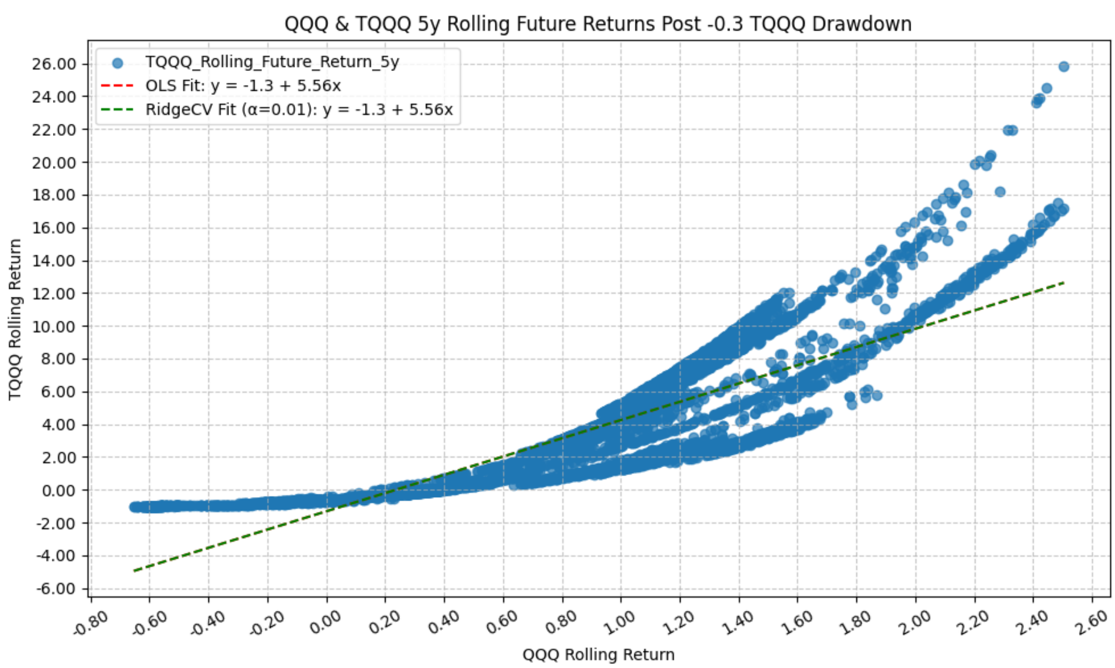





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_4y   R-squared:
```

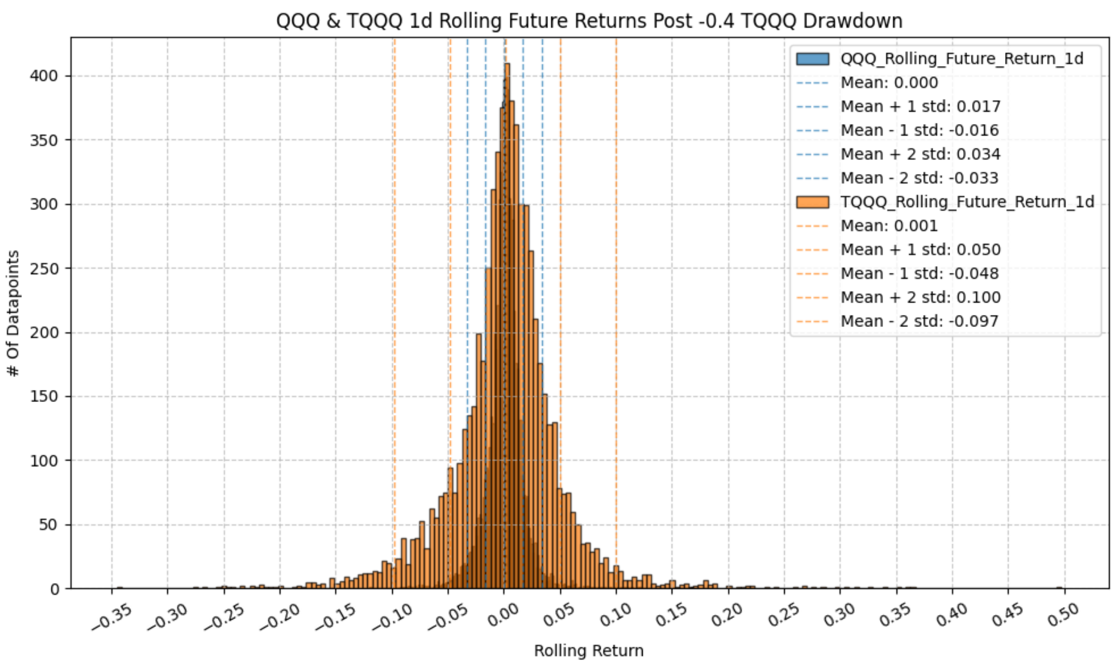
```
0.785
Model:                            OLS   Adj. R-squared:
0.785
Method:                 Least Squares   F-statistic:
2.017e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:48   Log-Likelihood:
-8250.6
No. Observations:                5524   AIC:
1.651e+04
Df Residuals:                    5522   BIC:
1.652e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.5497      0.024    -23.230      0.000
-0.596      -0.503
QQQ_Rolling_Future_Return_4y   4.2450      0.030    142.023      0.000
4.186       4.304
==============================================================================
Omnibus:                       72.624   Durbin-Watson:                   0.010
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               55.217
Skew:                           0.155   Prob(JB):                     1.02e-12
Kurtosis:                       2.620   Cond. No.                         3.02
==============================================================================

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

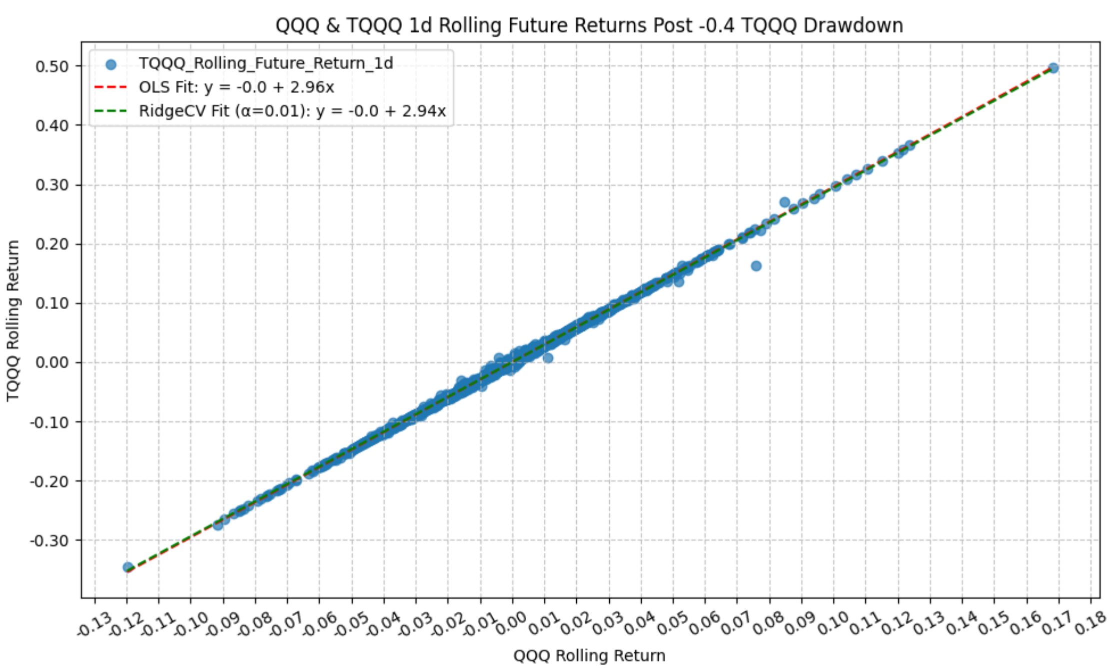





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_5y   R-squared:
```

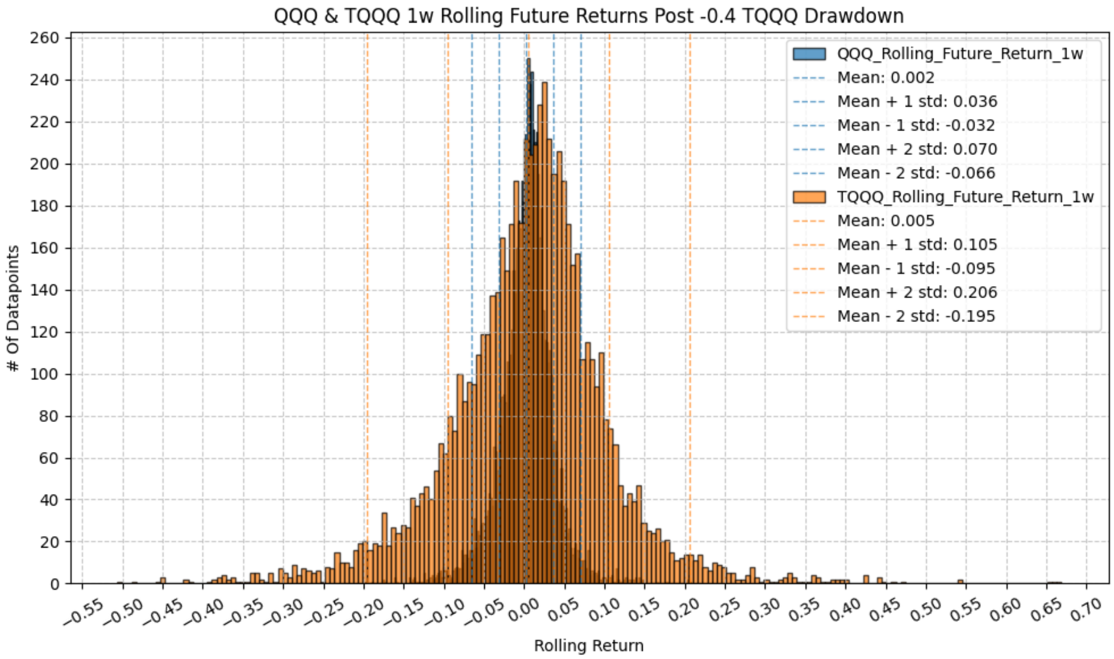
```
0.748
Model:                            OLS   Adj. R-squared:
0.747
Method:                 Least Squares   F-statistic:
1.560e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:49   Log-Likelihood:
-11434.
No. Observations:                5272   AIC:
2.287e+04
Df Residuals:                    5270   BIC:
2.288e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -1.3156      0.049    -26.822      0.000
-1.412      -1.219
QQQ_Rolling_Future_Return_5y    5.5645      0.045    124.913      0.000
5.477       5.652
==============================================================================
Omnibus:                      246.317   Durbin-Watson:                   0.009
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              368.513
Skew:                           0.424   Prob(JB):                     9.51e-81
Kurtosis:                       3.980   Cond. No.                         3.05
==============================================================================

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

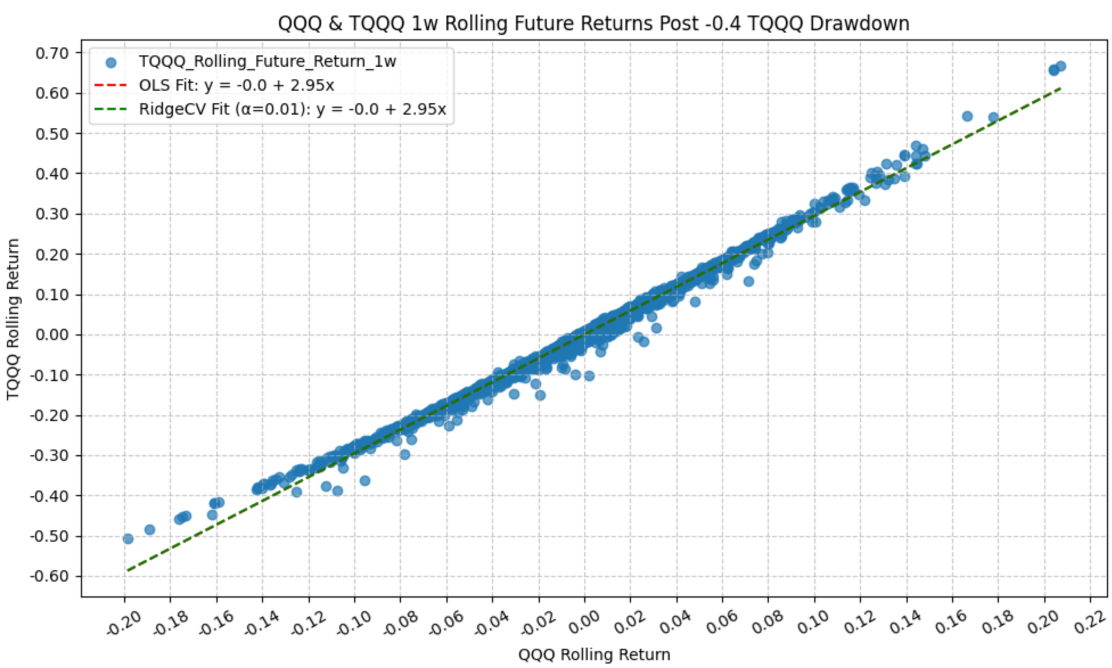





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1d   R-squared:
```

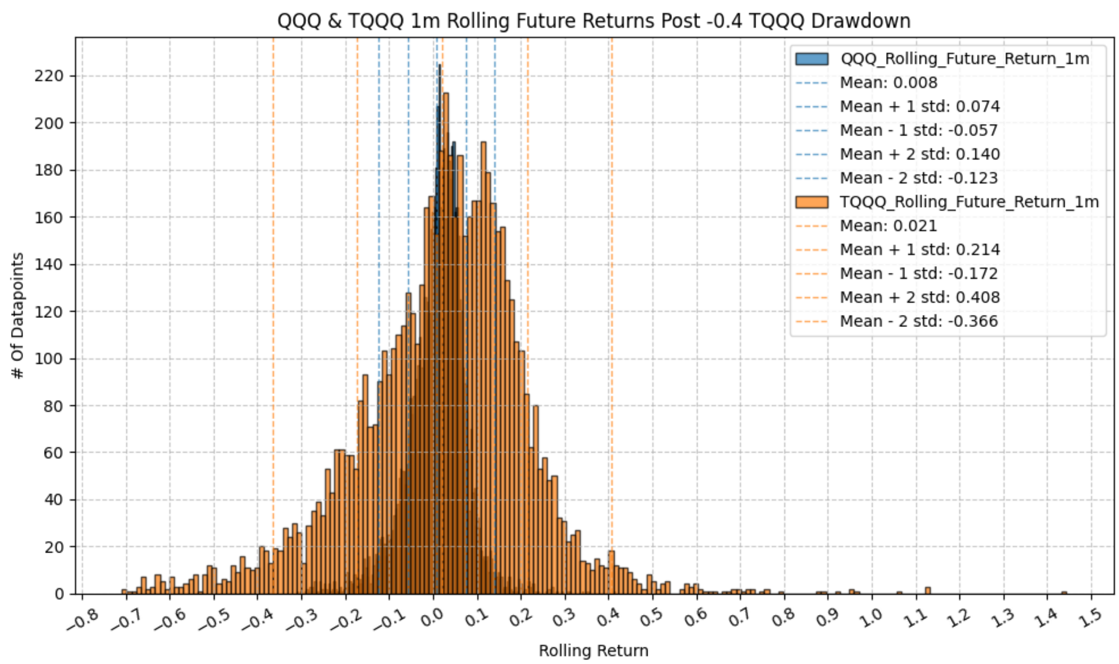
```
0.999
Model:                                    OLS   Adj. R-squared:
0.999
Method:                         Least Squares   F-statistic:
6.385e+06
Date:                        Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                14:26:50   Log-Likelihood:
32833.
No. Observations:                        6520   AIC:
-6.566e+04
Df Residuals:                            6518   BIC:
-6.565e+04
Df Model:                                   1
Covariance Type:                    nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                      -5.305e-05   1.95e-05     -2.721      0.007
-9.13e-05   -1.48e-05
QQQ_Rolling_Future_Return_1d     2.9551      0.001   2526.915      0.000
2.953       2.957
==============================================================================
Omnibus:                     9673.351   Durbin-Watson:                   2.565
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         38764591.768
Skew:                          -8.106   Prob(JB):                         0.00
Kurtosis:                     380.398   Cond. No.                         60.0
==============================================================================

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

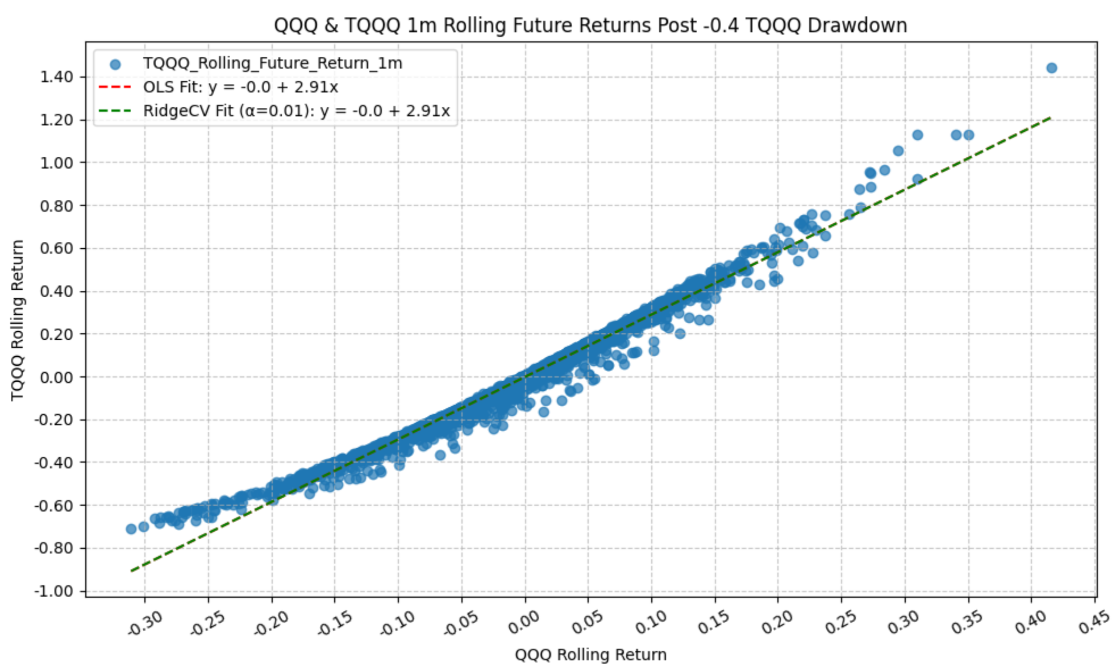





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1w   R-squared:
```

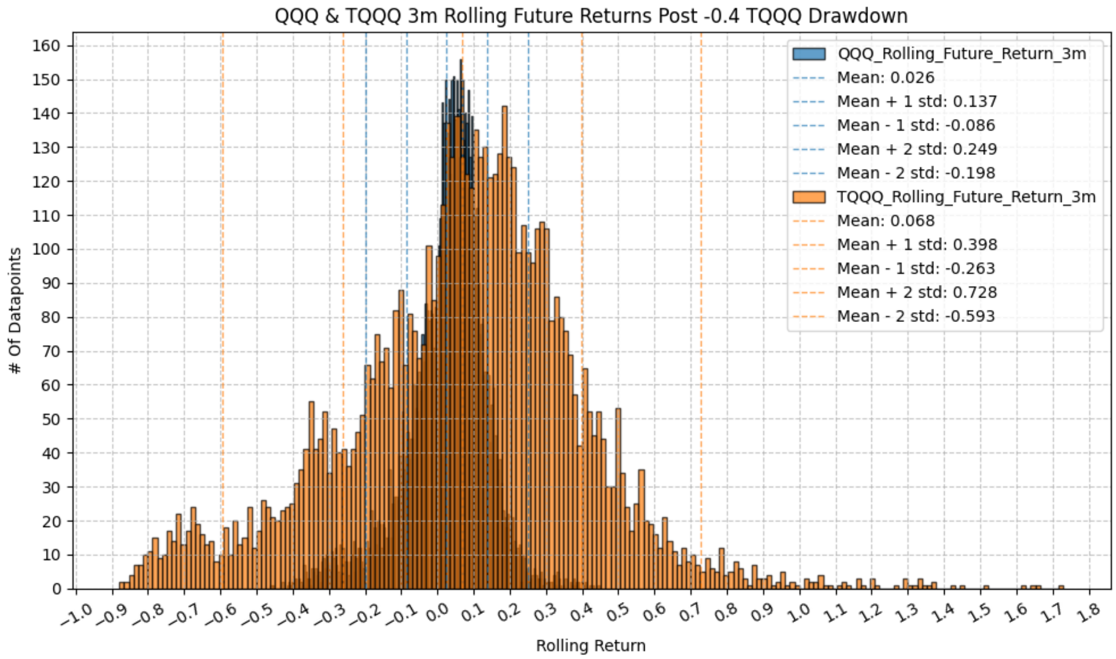
```
0.994
Model:                            OLS   Adj. R-squared:
0.994
Method:                 Least Squares   F-statistic:
1.118e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:52   Log-Likelihood:
22527.
No. Observations:                6516   AIC:
-4.505e+04
Df Residuals:                    6514   BIC:
-4.504e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0008   9.47e-05     -8.566      0.000
-0.001      -0.001
QQQ_Rolling_Future_Return_1w   2.9535      0.003   1057.421      0.000
2.948       2.959
==============================================================================
Omnibus:                     3593.998   Durbin-Watson:                   0.881
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           403875.873
Skew:                          -1.687   Prob(JB):                         0.00
Kurtosis:                      41.421   Cond. No.                         29.6
==============================================================================

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

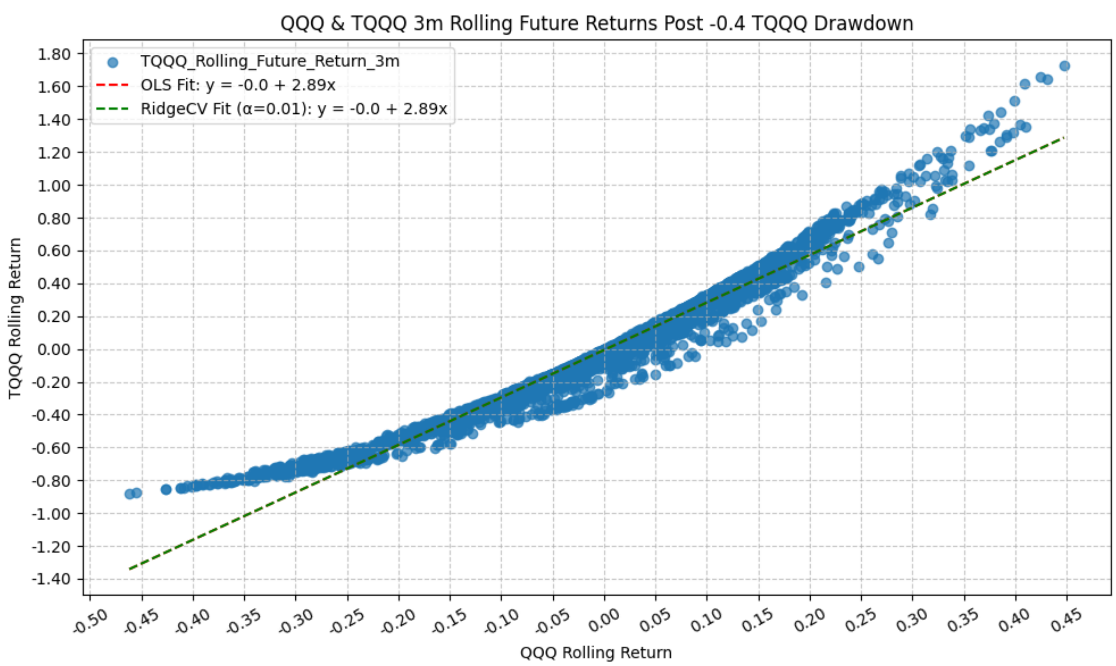





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_1m   R-squared:
```

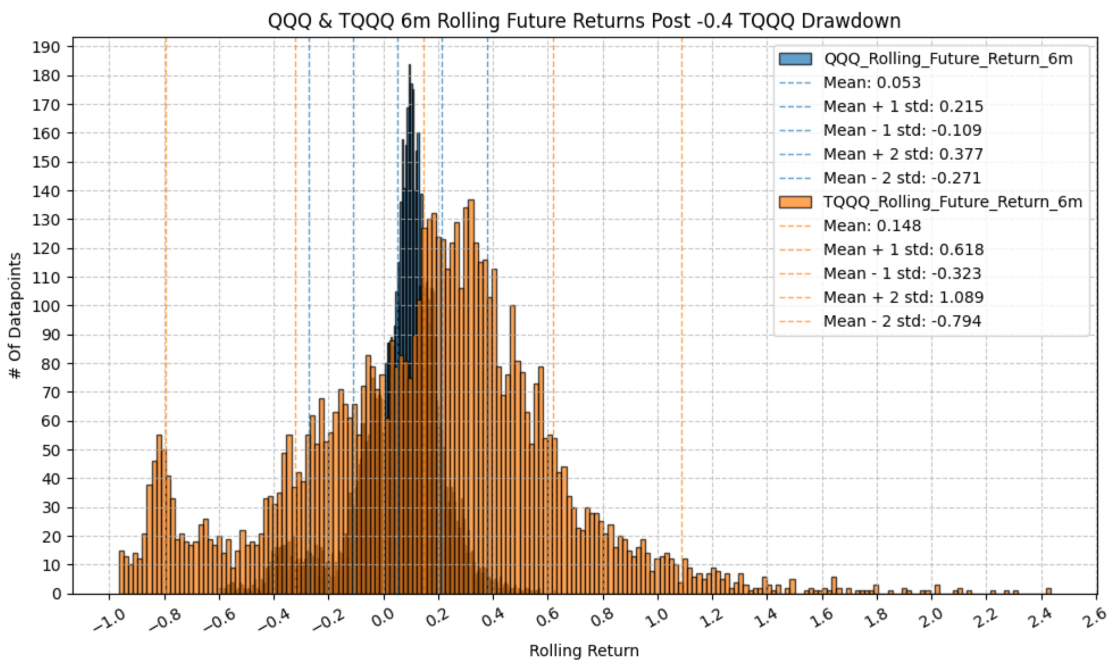
```
0.983
Model:                            OLS   Adj. R-squared:
0.983
Method:                 Least Squares   F-statistic:
3.661e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:53   Log-Likelihood:
14619.
No. Observations:                6500   AIC:
-2.923e+04
Df Residuals:                    6498   BIC:
-2.922e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0035      0.000    -11.021      0.000
-0.004      -0.003
QQQ_Rolling_Future_Return_1m   2.9150      0.005    605.092      0.000
2.906       2.924
==============================================================================
Omnibus:                     1510.573   Durbin-Watson:                   0.297
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            82826.988
Skew:                           0.062   Prob(JB):                         0.00
Kurtosis:                      20.487   Cond. No.                         15.2
==============================================================================

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

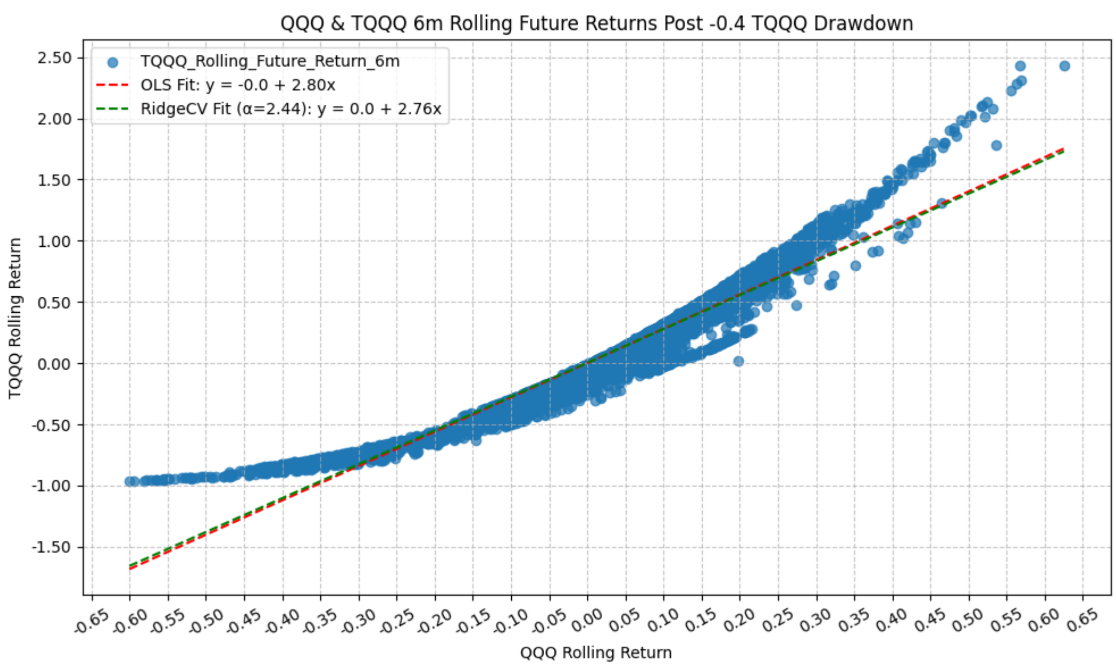





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_3m   R-squared:
```

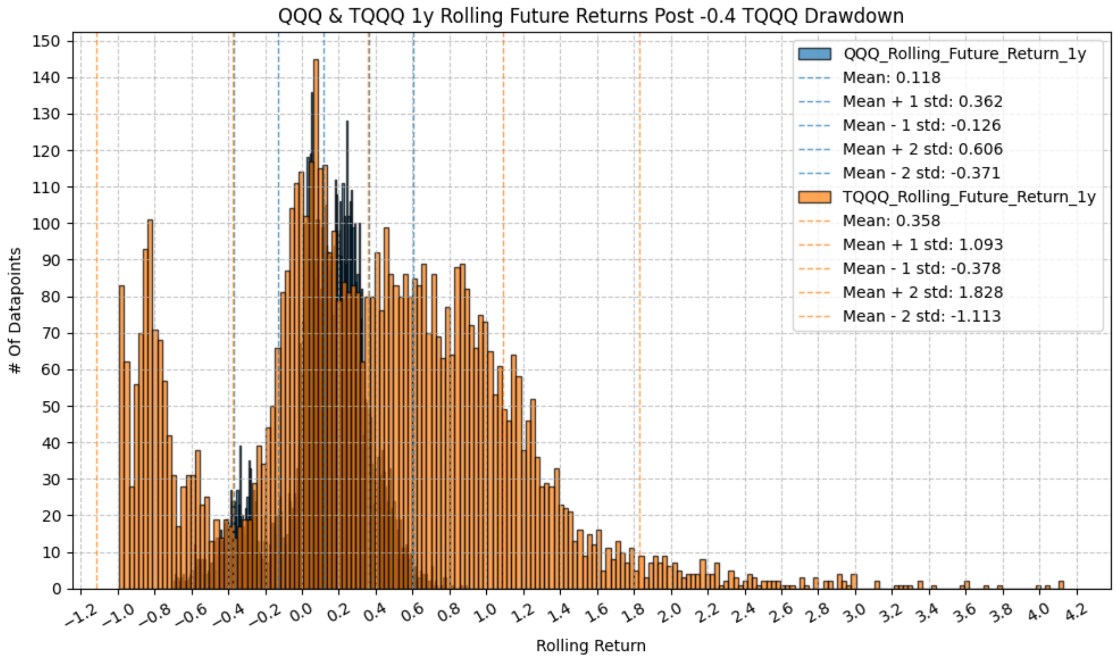
```
0.961
Model:                            OLS   Adj. R-squared:
0.961
Method:                 Least Squares   F-statistic:
1.591e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:54   Log-Likelihood:
8471.5
No. Observations:                6458   AIC:
-1.694e+04
Df Residuals:                    6456   BIC:
-1.693e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0065      0.001     -7.870      0.000
-0.008      -0.005
QQQ_Rolling_Future_Return_3m   2.8924      0.007    398.870      0.000
2.878       2.907
==============================================================================
Omnibus:                     1376.418   Durbin-Watson:                   0.101
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            15591.855
Skew:                           0.692   Prob(JB):                         0.00
Kurtosis:                      10.485   Cond. No.                         8.95
==============================================================================

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

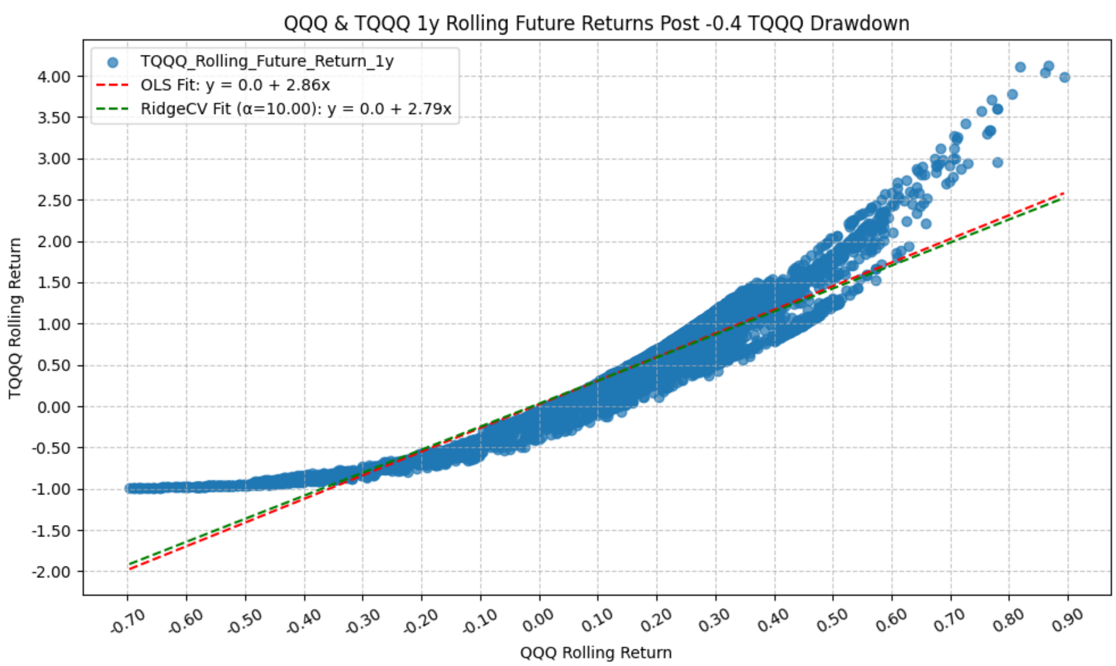





```
                               OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_6m   R-squared:
```

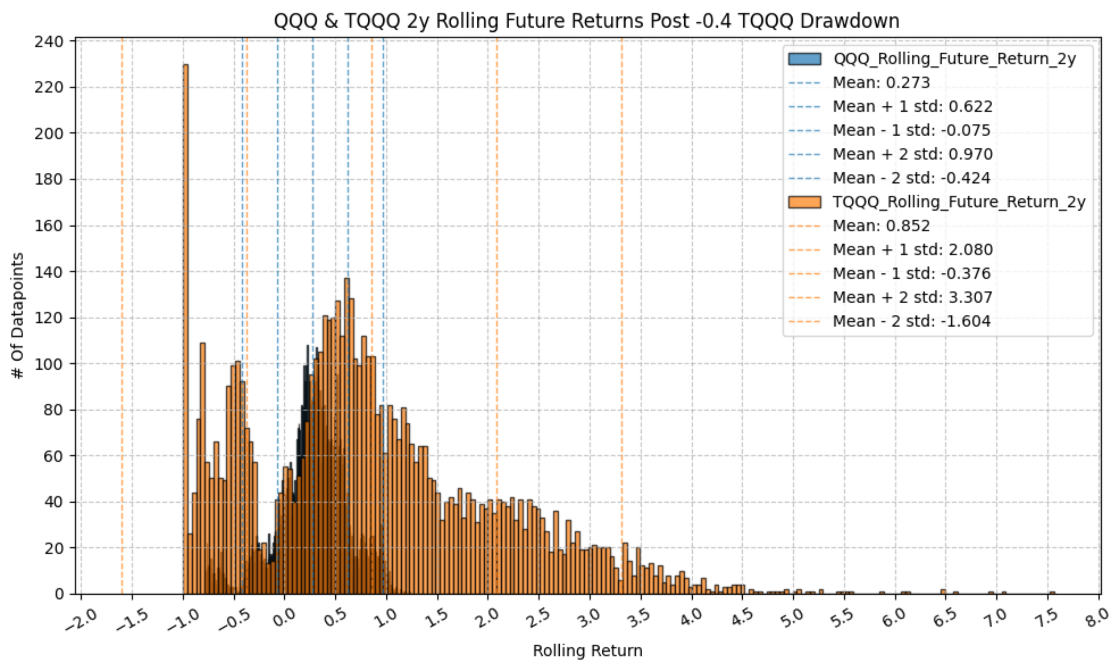
```
0.931
Model:                                    OLS   Adj. R-squared:
0.931
Method:                         Least Squares   F-statistic:
8.656e+04
Date:                        Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                14:26:55   Log-Likelihood:
4305.0
No. Observations:                        6395   AIC:
-8606.
Df Residuals:                            6393   BIC:
-8593.
Df Model:                                   1
Covariance Type:                    nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                        -4.855e-06      0.002     -0.003      0.998
-0.003       0.003
QQQ_Rolling_Future_Return_6m     2.8036      0.010    294.207      0.000
2.785       2.822
==============================================================================
Omnibus:                     1637.994   Durbin-Watson:                   0.057
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8138.991
Skew:                           1.146   Prob(JB):                         0.00
Kurtosis:                       8.029   Cond. No.                         6.19
==============================================================================

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

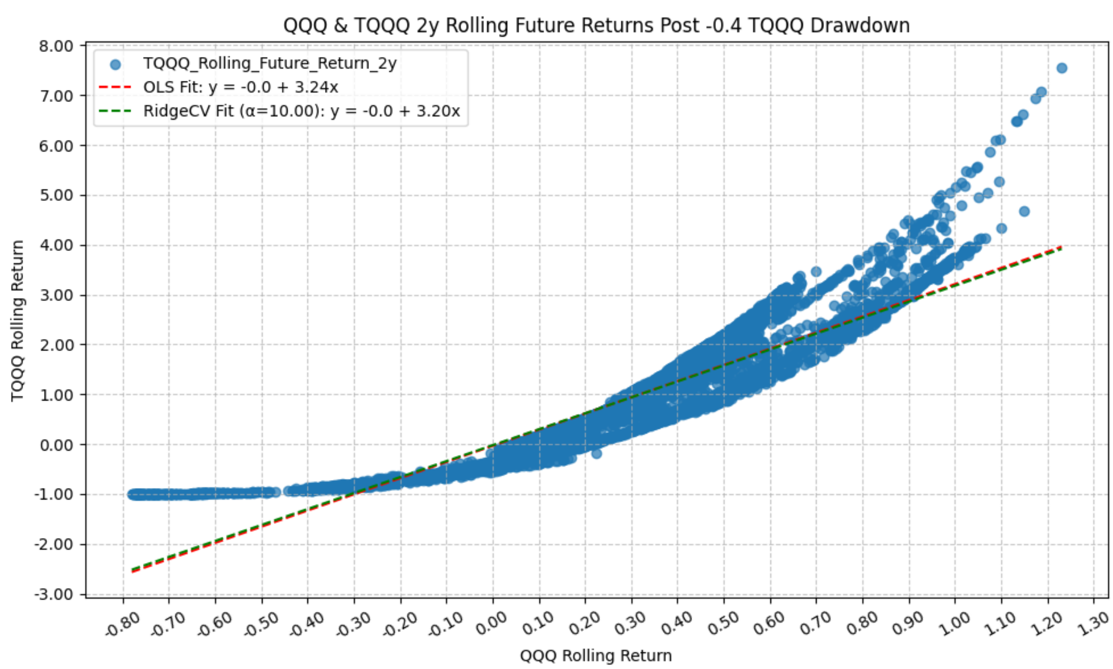





```
                              OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1y   R-squared:
```

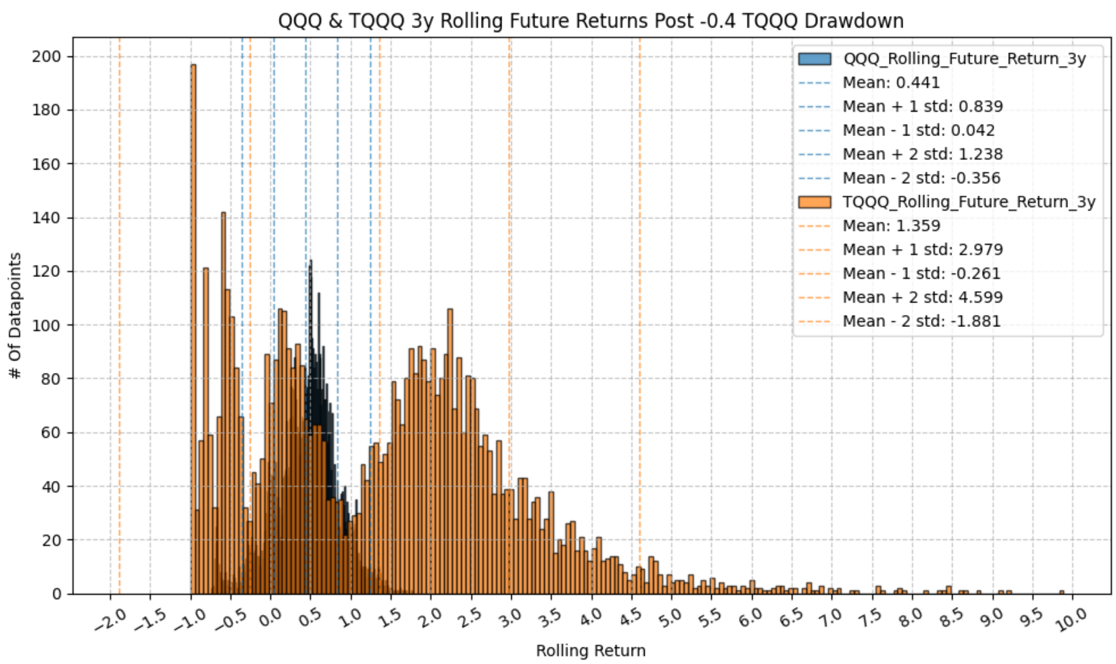
```
0.902
Model:                            OLS   Adj. R-squared:
0.902
Method:                 Least Squares   F-statistic:
5.795e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:57   Log-Likelihood:
326.09
No. Observations:                6269   AIC:
-648.2
Df Residuals:                    6267   BIC:
-634.7
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          0.0211      0.003      6.535      0.000
0.015       0.027
QQQ_Rolling_Future_Return_1y   2.8618      0.012    240.727      0.000
2.838       2.885
==============================================================================
Omnibus:                     1984.175   Durbin-Watson:                   0.039
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8573.296
Skew:                           1.494   Prob(JB):                         0.00
Kurtosis:                       7.888   Cond. No.                         4.16
==============================================================================

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

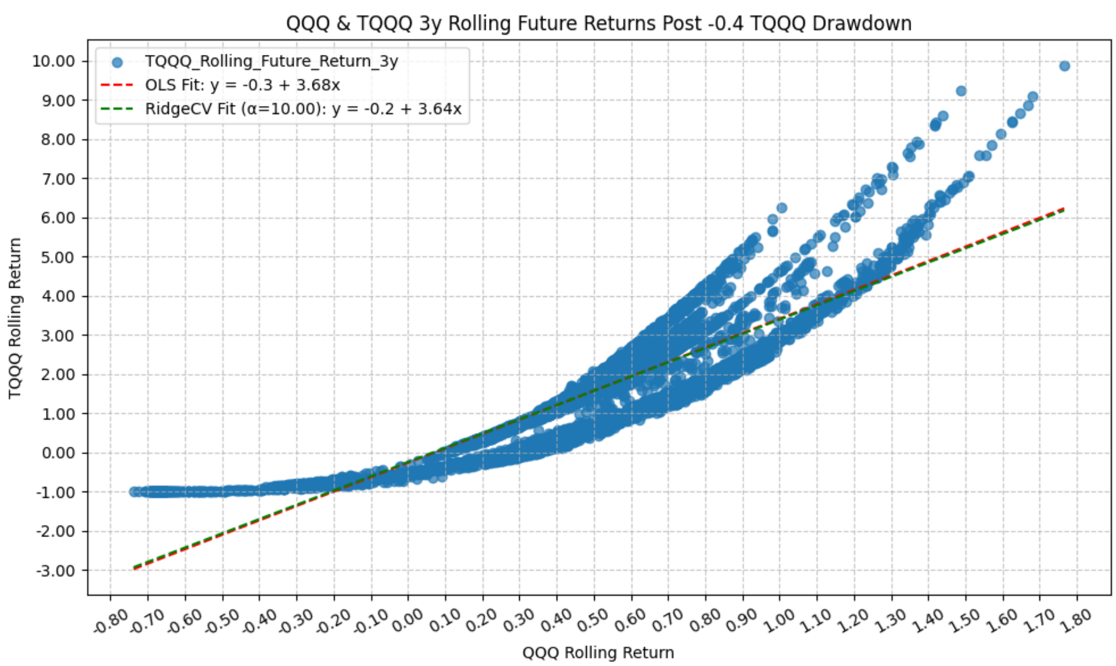





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_2y   R-squared:
```

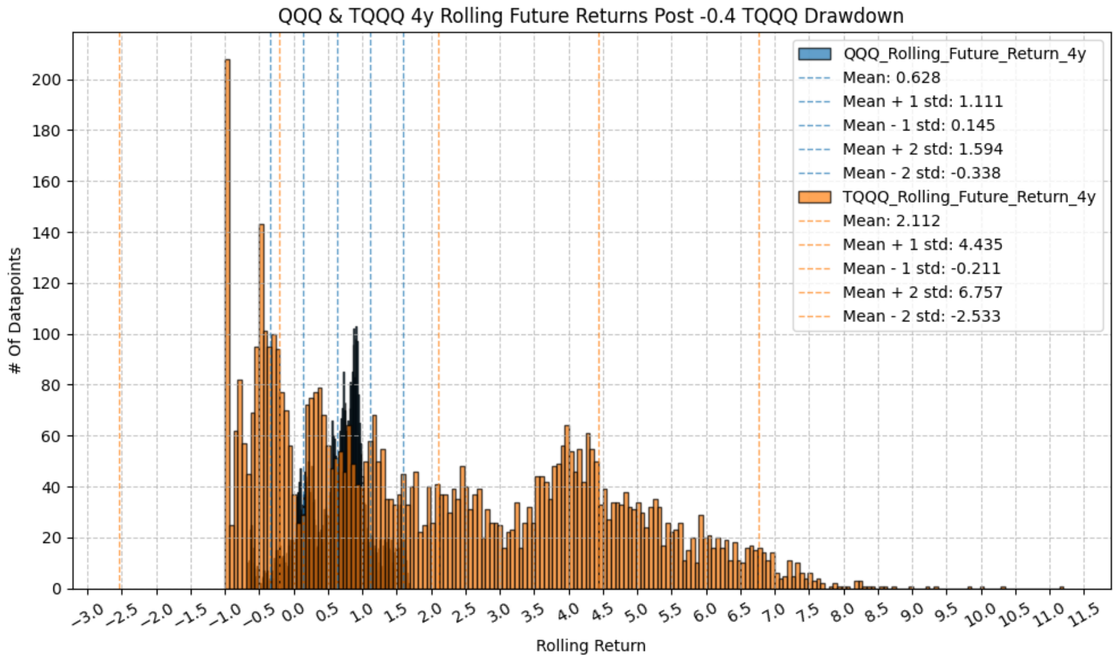
```
0.847
Model:                                OLS   Adj. R-squared:
0.847
Method:                     Least Squares   F-statistic:
3.333e+04
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:26:58   Log-Likelihood:
-4121.6
No. Observations:                    6017   AIC:
8247.
Df Residuals:                        6015   BIC:
8261.
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
================
                                coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                        -0.0345      0.008     -4.386      0.000
-0.050      -0.019
QQQ_Rolling_Future_Return_2y   3.2439      0.018    182.575      0.000
3.209       3.279
==============================================================================
Omnibus:                     1712.301   Durbin-Watson:                   0.019
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             5037.509
Skew:                           1.480   Prob(JB):                         0.00
Kurtosis:                       6.367   Cond. No.                         3.11
==============================================================================

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

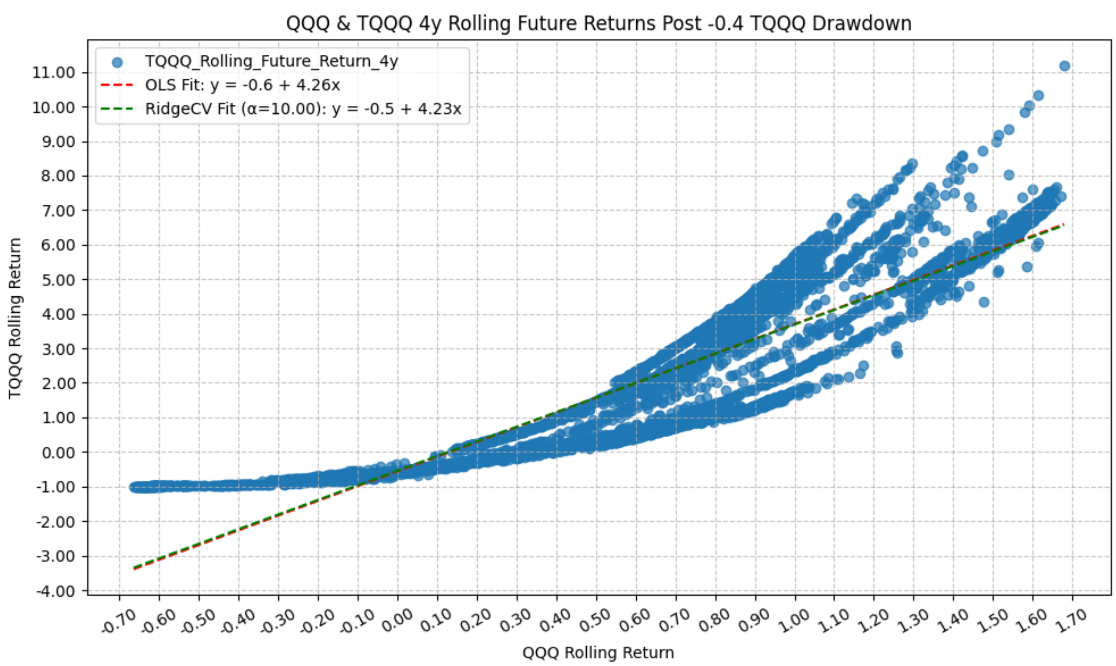





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3y   R-squared:
```

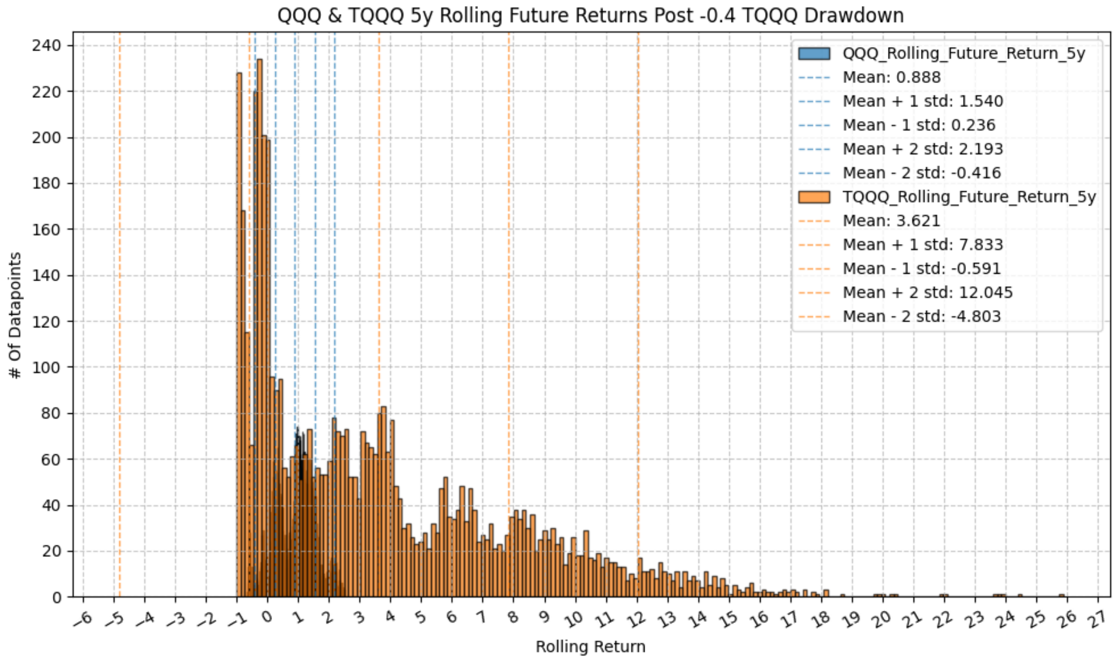
```
0.817
Model:                            OLS   Adj. R-squared:
0.817
Method:                 Least Squares   F-statistic:
2.581e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:26:59   Log-Likelihood:
-6058.9
No. Observations:                5765   AIC:
1.212e+04
Df Residuals:                    5763   BIC:
1.214e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.2618      0.014    -19.253      0.000
-0.288      -0.235
QQQ_Rolling_Future_Return_3y   3.6767      0.023    160.644      0.000
3.632       3.722
==============================================================================
Omnibus:                      869.452   Durbin-Watson:                   0.015
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1585.916
Skew:                           0.962   Prob(JB):                         0.00
Kurtosis:                       4.703   Cond. No.                         3.07
==============================================================================

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

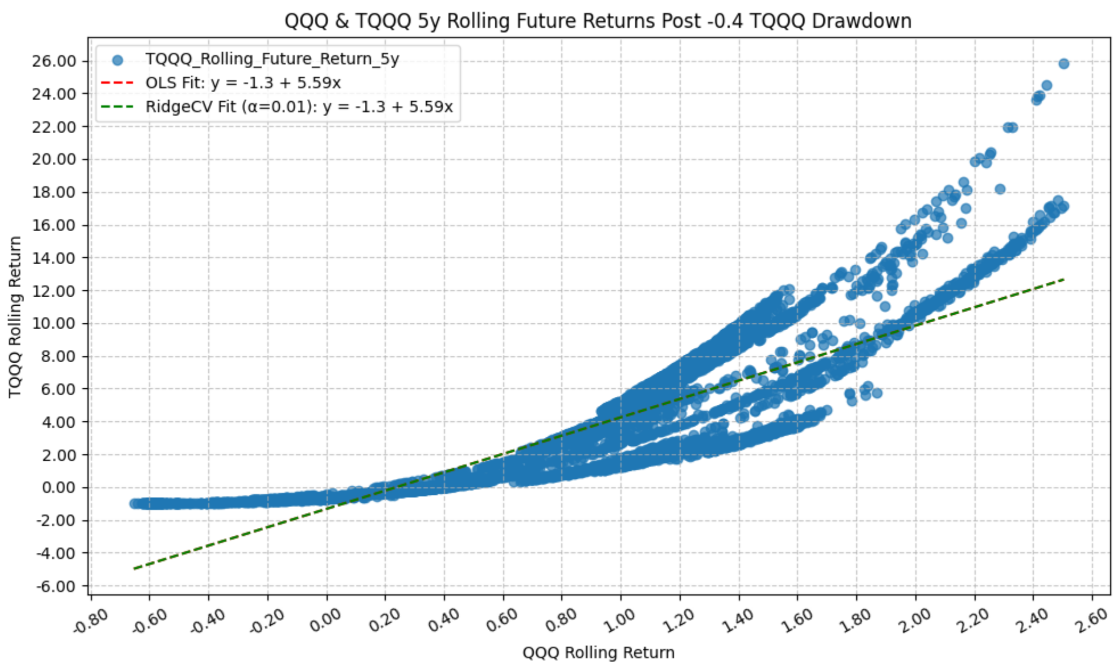





```
                              OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_4y   R-squared:
```

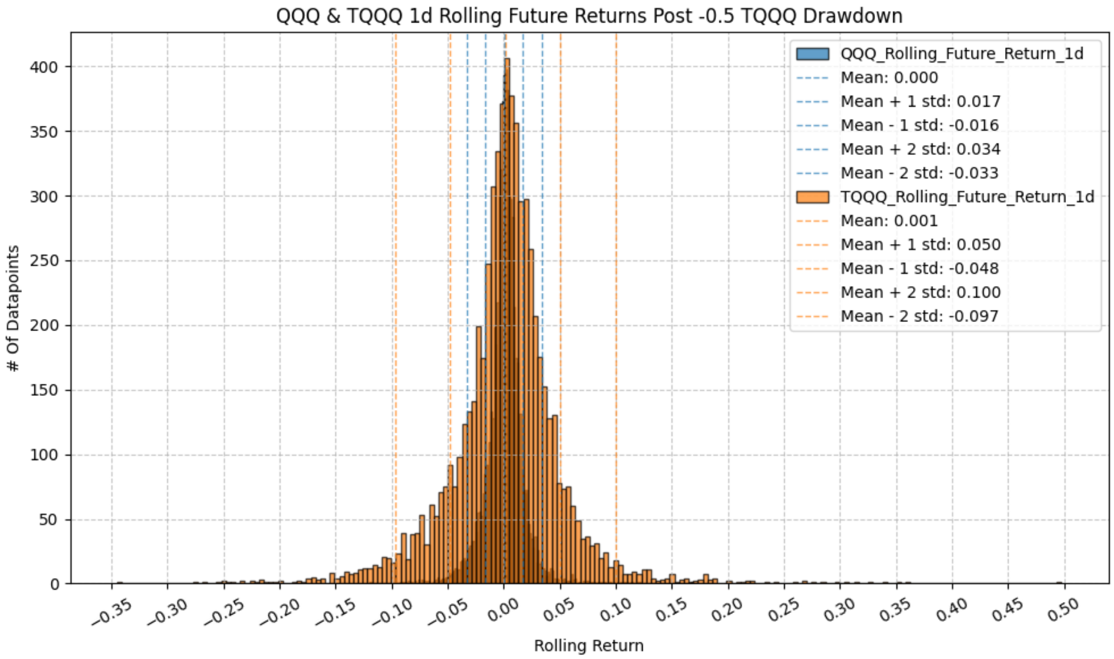
```
0.786
Model:                                 OLS   Adj. R-squared:
0.786
Method:                      Least Squares   F-statistic:
2.019e+04
Date:                     Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                             14:27:00   Log-Likelihood:
-8223.4
No. Observations:                     5513   AIC:
1.645e+04
Df Residuals:                         5511   BIC:
1.646e+04
Df Model:                                1
Covariance Type:                 nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.5646      0.024    -23.758      0.000
-0.611      -0.518
QQQ_Rolling_Future_Return_4y   4.2630      0.030    142.094      0.000
4.204       4.322
==============================================================================
Omnibus:                       67.431   Durbin-Watson:                   0.010
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               52.172
Skew:                           0.153   Prob(JB):                     4.69e-12
Kurtosis:                       2.634   Cond. No.                         3.04
==============================================================================

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

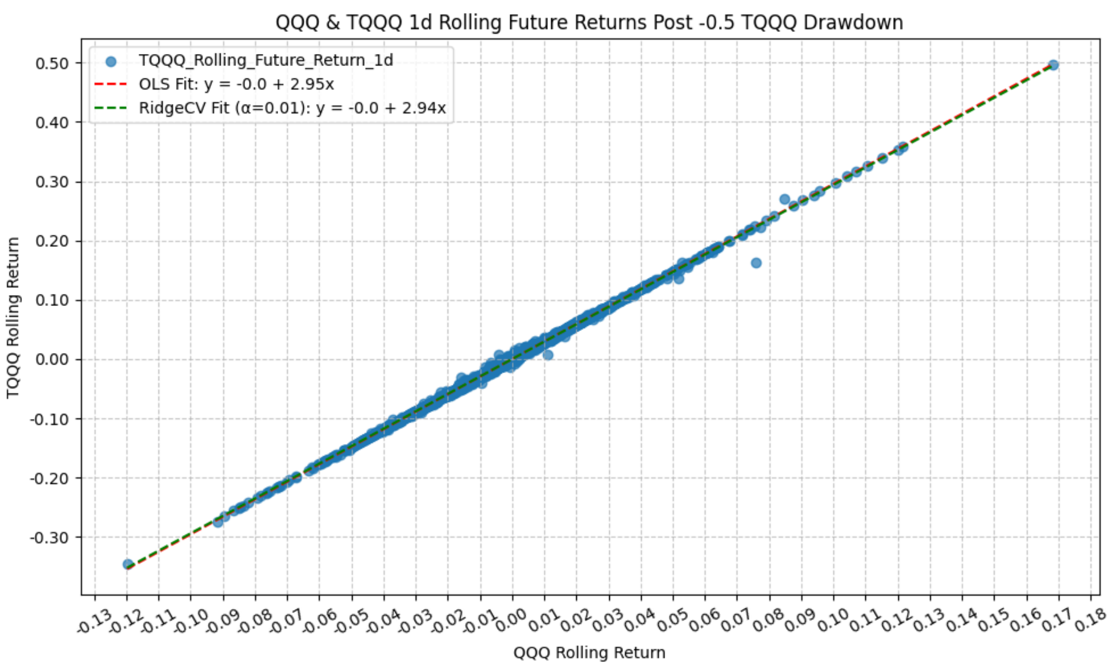





```
                                 OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_5y   R-squared:
```

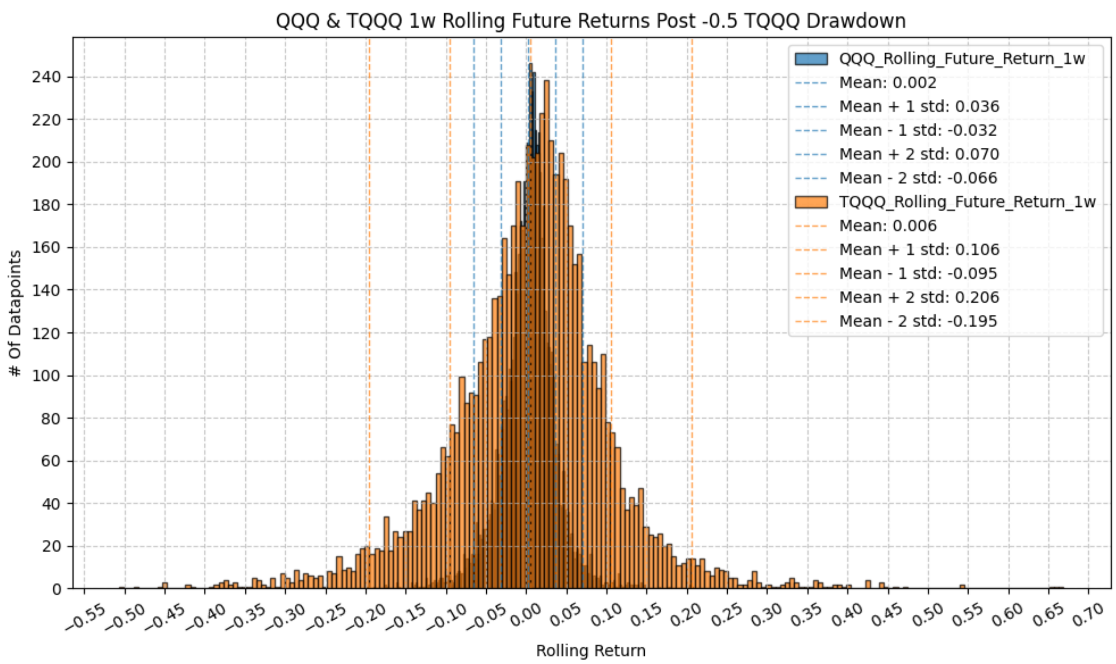
```
0.748
Model:                            OLS   Adj. R-squared:
0.748
Method:                 Least Squares   F-statistic:
1.562e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:01   Log-Likelihood:
-11403.
No. Observations:                5261   AIC:
2.281e+04
Df Residuals:                    5259   BIC:
2.282e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -1.3405      0.049    -27.216      0.000
-1.437      -1.244
QQQ_Rolling_Future_Return_5y   5.5855      0.045    124.962      0.000
5.498       5.673
==============================================================================
Omnibus:                      241.818   Durbin-Watson:                   0.009
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              363.534
Skew:                           0.417   Prob(JB):                     1.15e-79
Kurtosis:                       3.981   Cond. No.                         3.07
==============================================================================

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

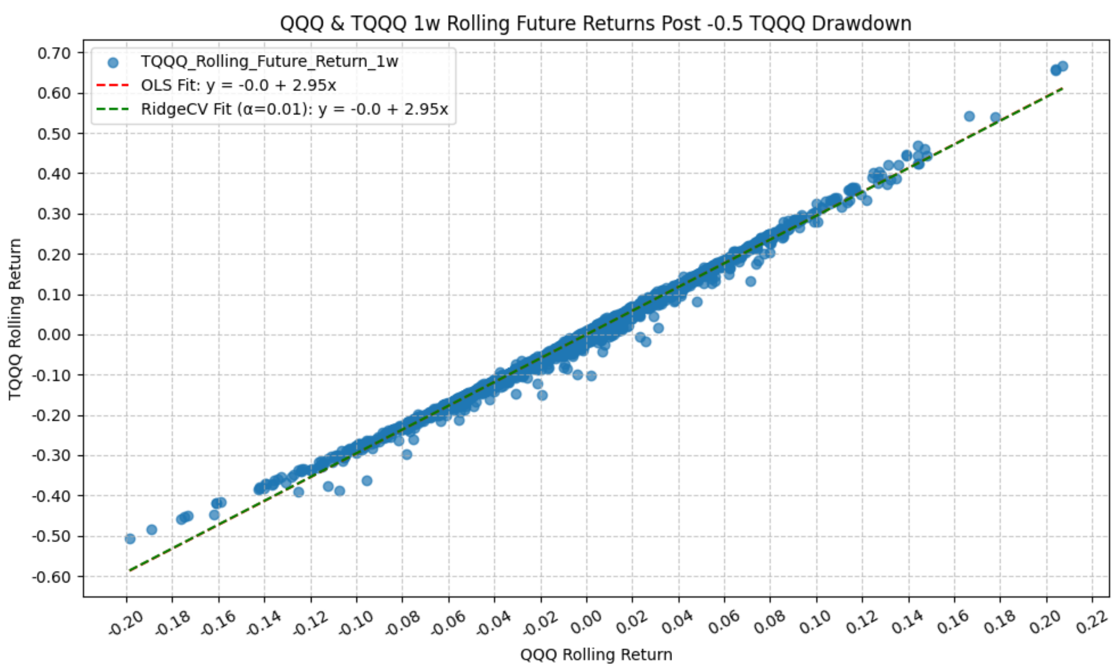





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1d   R-squared:
```

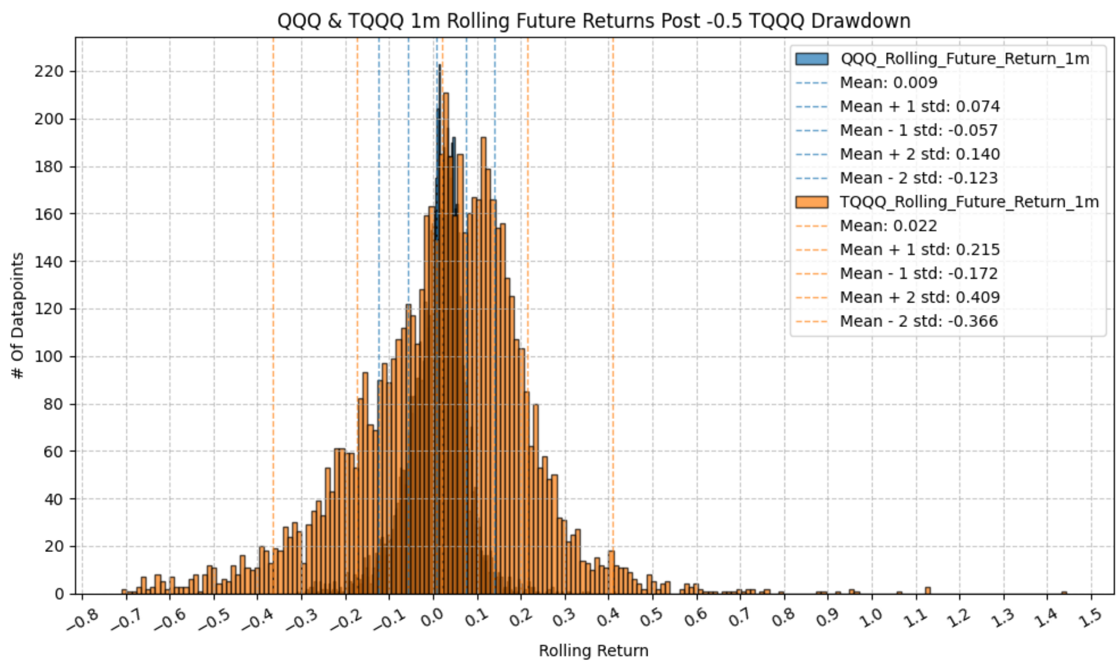
```
0.999
Model:                            OLS   Adj. R-squared:
0.999
Method:                 Least Squares   F-statistic:
6.255e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:03   Log-Likelihood:
32495.
No. Observations:                6457   AIC:
-6.499e+04
Df Residuals:                    6455   BIC:
-6.497e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                      -4.913e-05   1.97e-05     -2.500      0.012
-8.77e-05   -1.06e-05
QQQ_Rolling_Future_Return_1d     2.9549      0.001   2501.003      0.000
2.953       2.957
==============================================================================
Omnibus:                     9580.111   Durbin-Watson:                   2.567
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         38114515.631
Skew:                          -8.108   Prob(JB):                         0.00
Kurtosis:                     379.038   Cond. No.                         60.1
==============================================================================

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

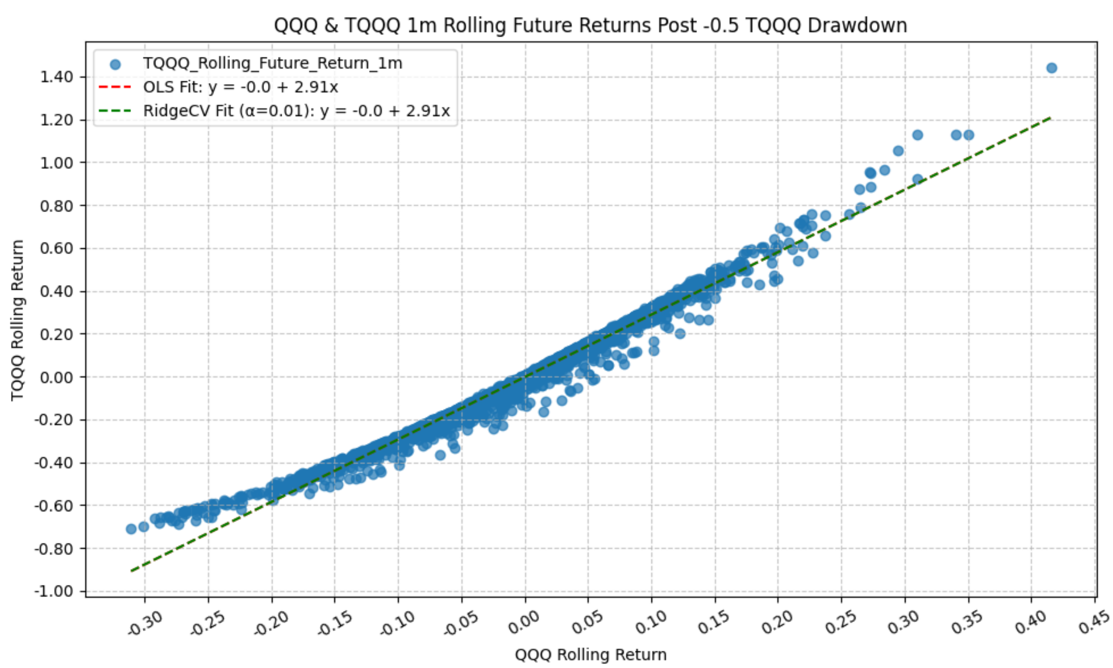





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1w   R-squared:
```

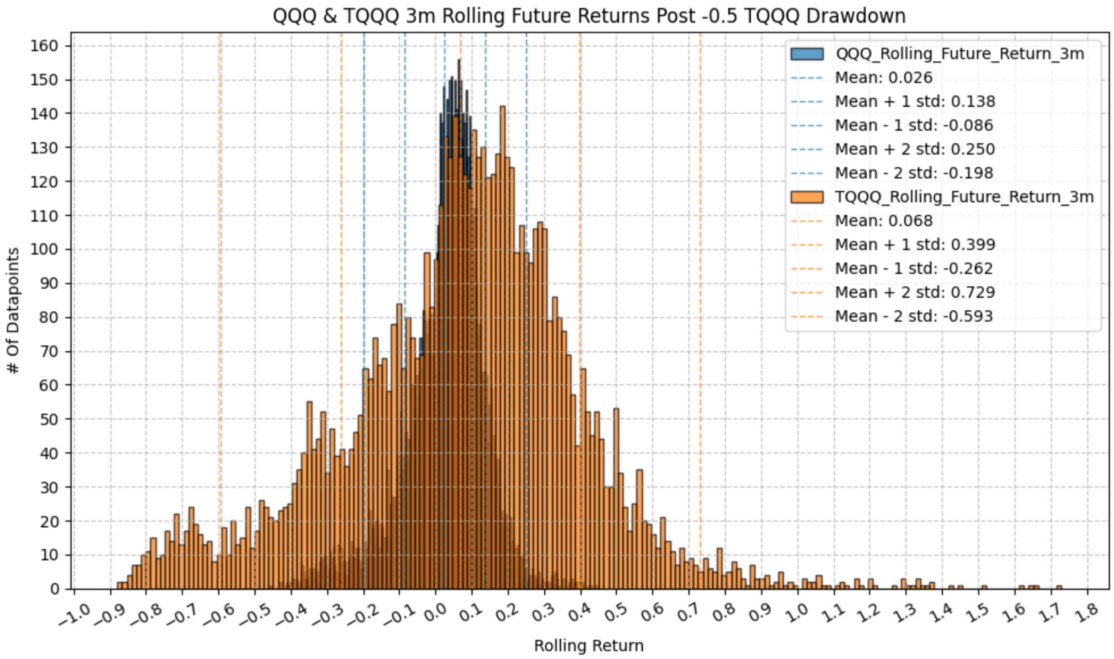
```
0.994
Model:                            OLS   Adj. R-squared:
0.994
Method:                 Least Squares   F-statistic:
1.109e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:04   Log-Likelihood:
22311.
No. Observations:                6453   AIC:
-4.462e+04
Df Residuals:                    6451   BIC:
-4.461e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0008   9.51e-05     -8.169      0.000
-0.001      -0.001
QQQ_Rolling_Future_Return_1w     2.9529      0.003   1053.321      0.000
2.947       2.958
==============================================================================
Omnibus:                     3540.518   Durbin-Watson:                   0.887
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           402393.065
Skew:                          -1.669   Prob(JB):                         0.00
Kurtosis:                      41.541   Cond. No.                         29.5
==============================================================================

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

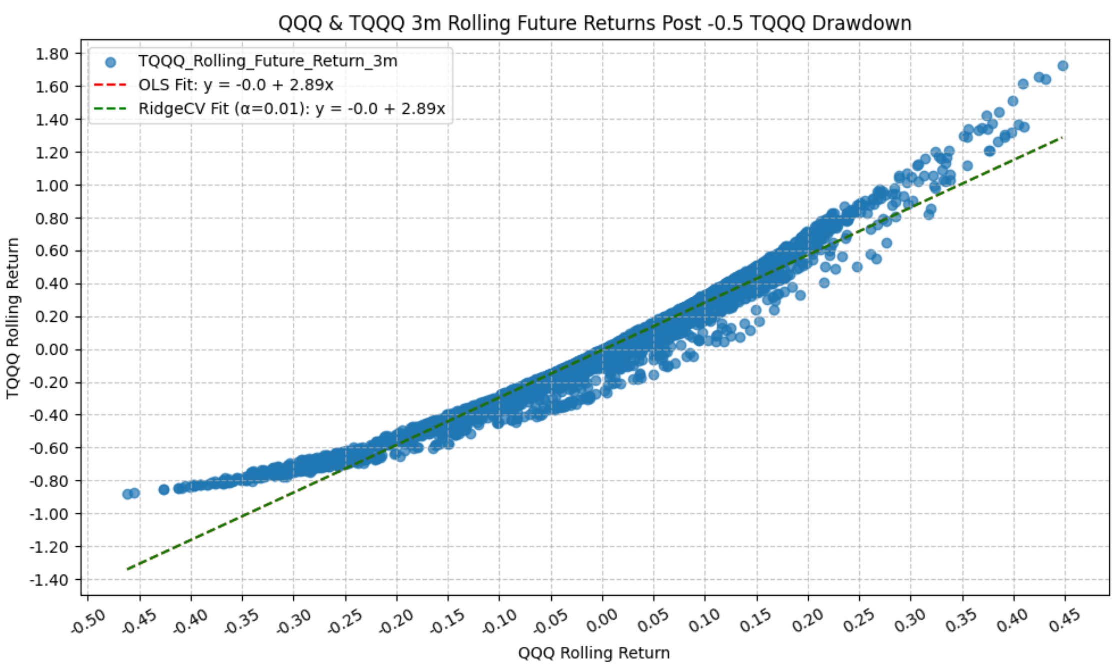





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1m   R-squared:
```

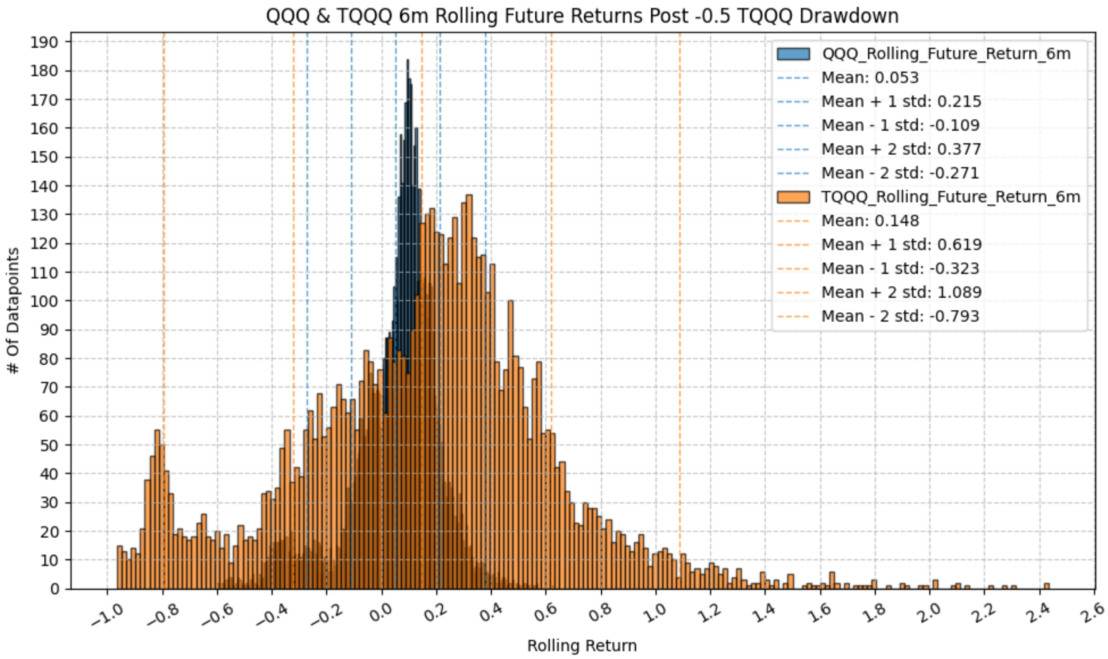
```
0.983
Model:                            OLS   Adj. R-squared:
0.983
Method:                 Least Squares   F-statistic:
3.615e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:05   Log-Likelihood:
14455.
No. Observations:                6437   AIC:
-2.891e+04
Df Residuals:                    6435   BIC:
-2.889e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0034      0.000    -10.594      0.000
-0.004      -0.003
QQQ_Rolling_Future_Return_1m    2.9144      0.005    601.219      0.000
2.905       2.924
==============================================================================
Omnibus:                     1490.690   Durbin-Watson:                   0.295
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            81043.655
Skew:                           0.049   Prob(JB):                         0.00
Kurtosis:                      20.383   Cond. No.                         15.2
==============================================================================

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

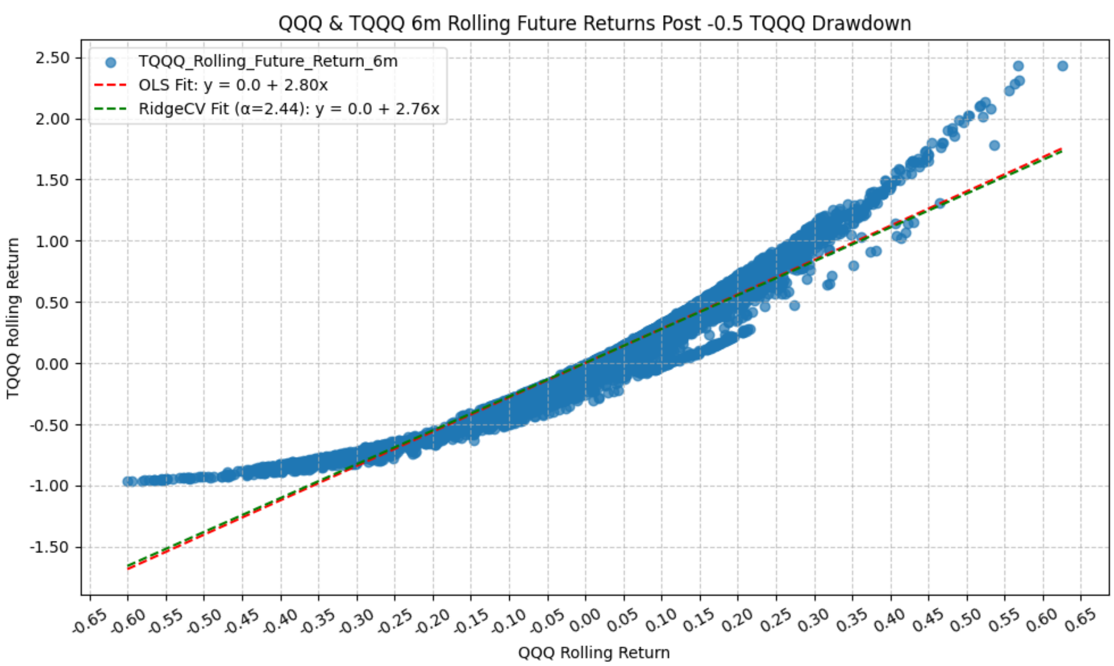





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3m   R-squared:
```

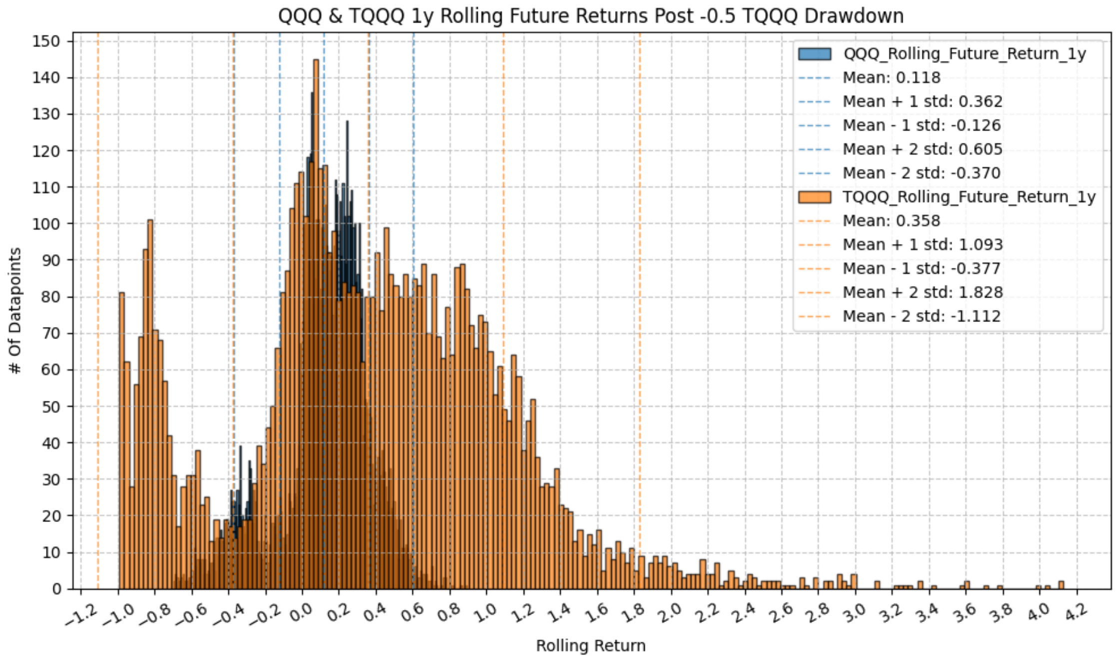
```
0.961
Model:                            OLS   Adj. R-squared:
0.961
Method:                 Least Squares   F-statistic:
1.589e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:06   Log-Likelihood:
8428.1
No. Observations:                6424   AIC:
-1.685e+04
Df Residuals:                    6422   BIC:
-1.684e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0063      0.001     -7.529      0.000
-0.008      -0.005
QQQ_Rolling_Future_Return_3m    2.8919      0.007    398.560      0.000
2.878       2.906
==============================================================================
Omnibus:                     1375.718   Durbin-Watson:                   0.101
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            15496.490
Skew:                           0.698   Prob(JB):                         0.00
Kurtosis:                      10.480   Cond. No.                         8.93
==============================================================================

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

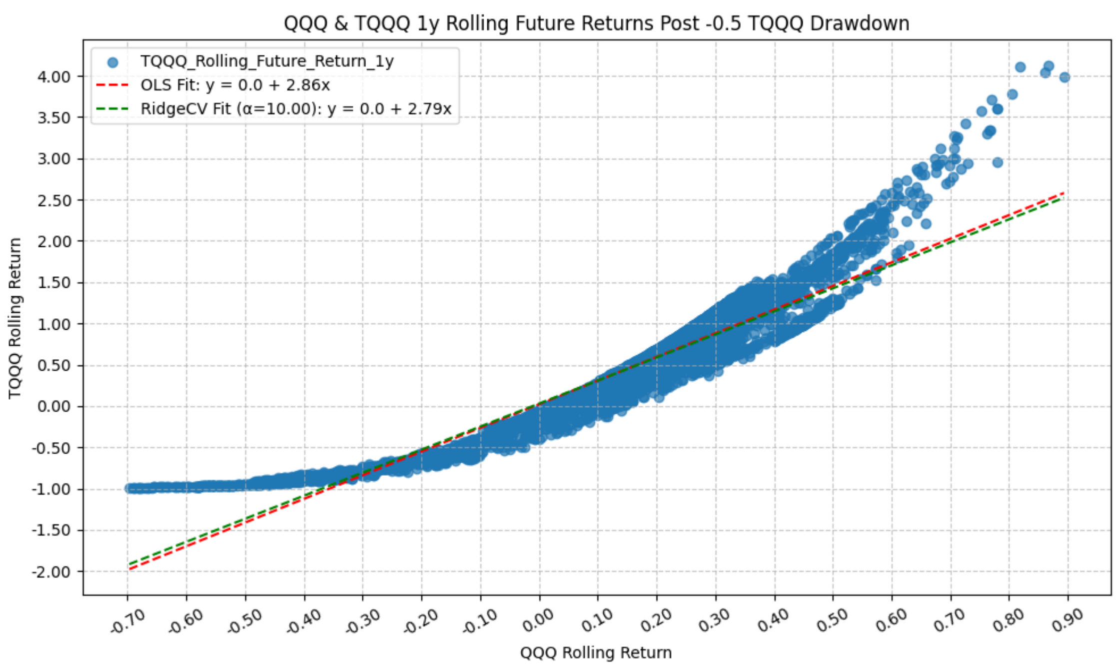





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_6m   R-squared:
```

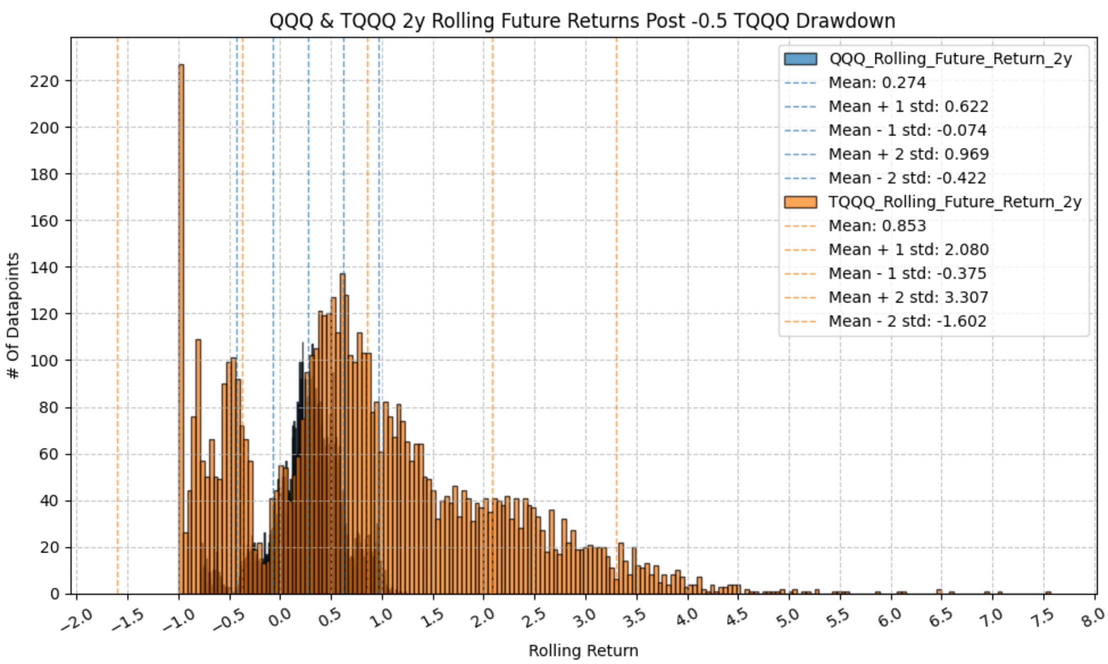
```
0.931
Model:                            OLS   Adj. R-squared:
0.931
Method:                 Least Squares   F-statistic:
8.673e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:07   Log-Likelihood:
4311.8
No. Observations:                6392   AIC:
-8620.
Df Residuals:                    6390   BIC:
-8606.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          0.0001      0.002      0.068      0.946
-0.003       0.003
QQQ_Rolling_Future_Return_6m   2.8037      0.010    294.503      0.000
2.785       2.822
==============================================================================
Omnibus:                     1653.772   Durbin-Watson:                   0.055
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8144.760
Skew:                           1.162   Prob(JB):                         0.00
Kurtosis:                       8.018   Cond. No.                         6.19
==============================================================================

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

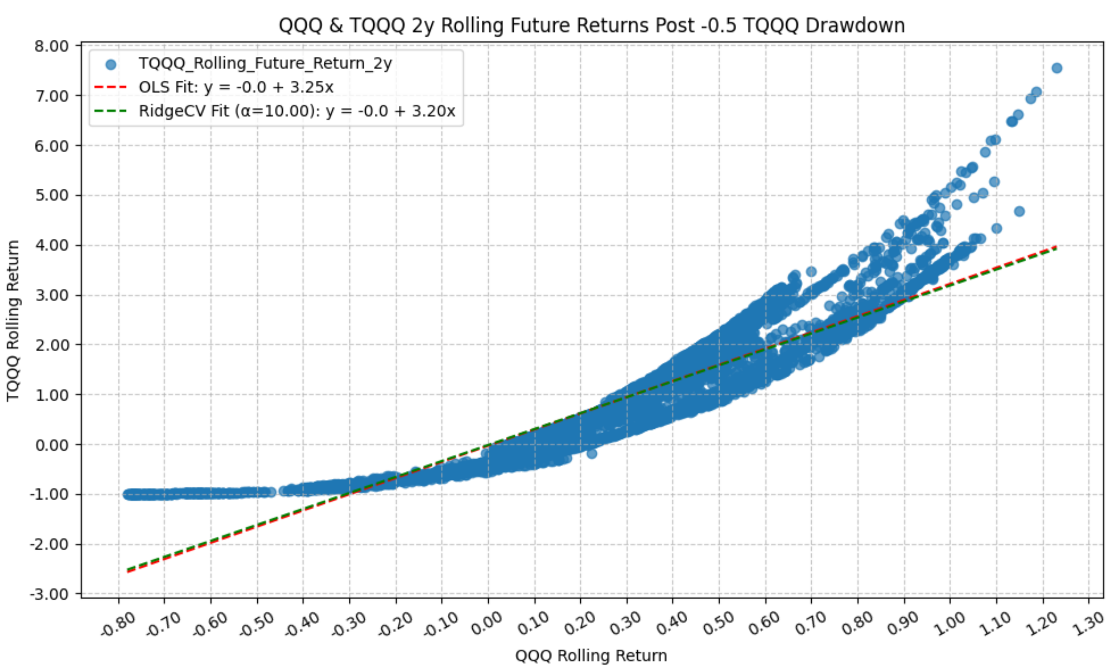





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_1y   R-squared:
```

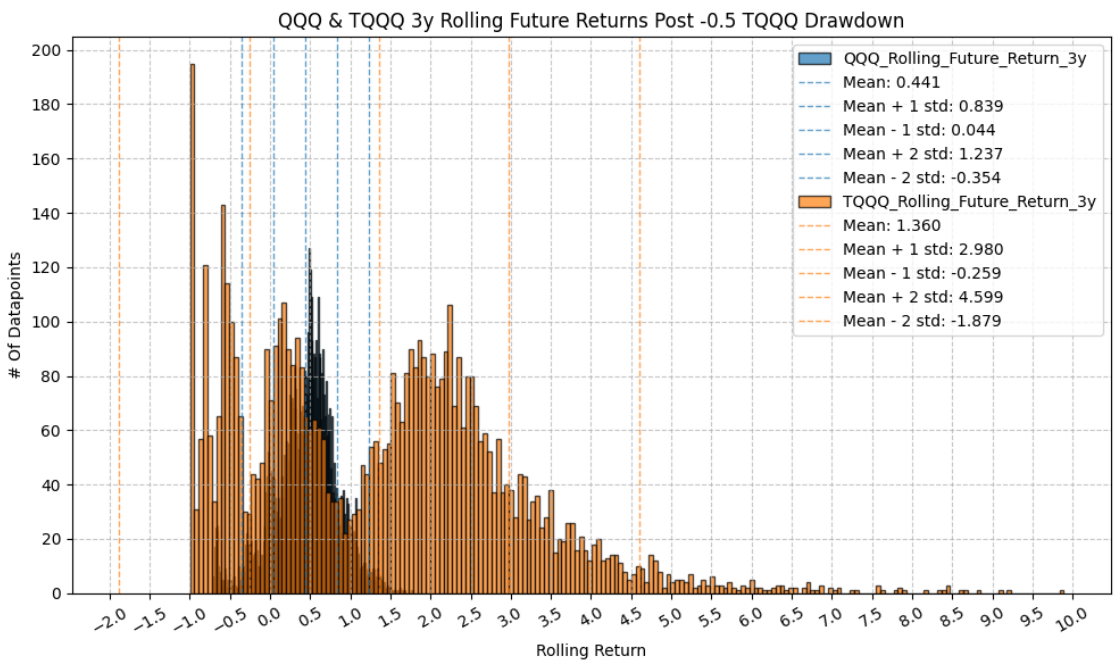
```
0.903
Model:                            OLS   Adj. R-squared:
0.903
Method:                 Least Squares   F-statistic:
5.801e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:09   Log-Likelihood:
333.68
No. Observations:                6266   AIC:
-663.4
Df Residuals:                    6264   BIC:
-649.9
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          0.0205      0.003      6.376      0.000
0.014       0.027
QQQ_Rolling_Future_Return_1y     2.8644      0.012    240.863      0.000
2.841       2.888
==============================================================================
Omnibus:                     1982.919   Durbin-Watson:                   0.038
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8590.359
Skew:                           1.493   Prob(JB):                         0.00
Kurtosis:                       7.898   Cond. No.                         4.16
==============================================================================

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

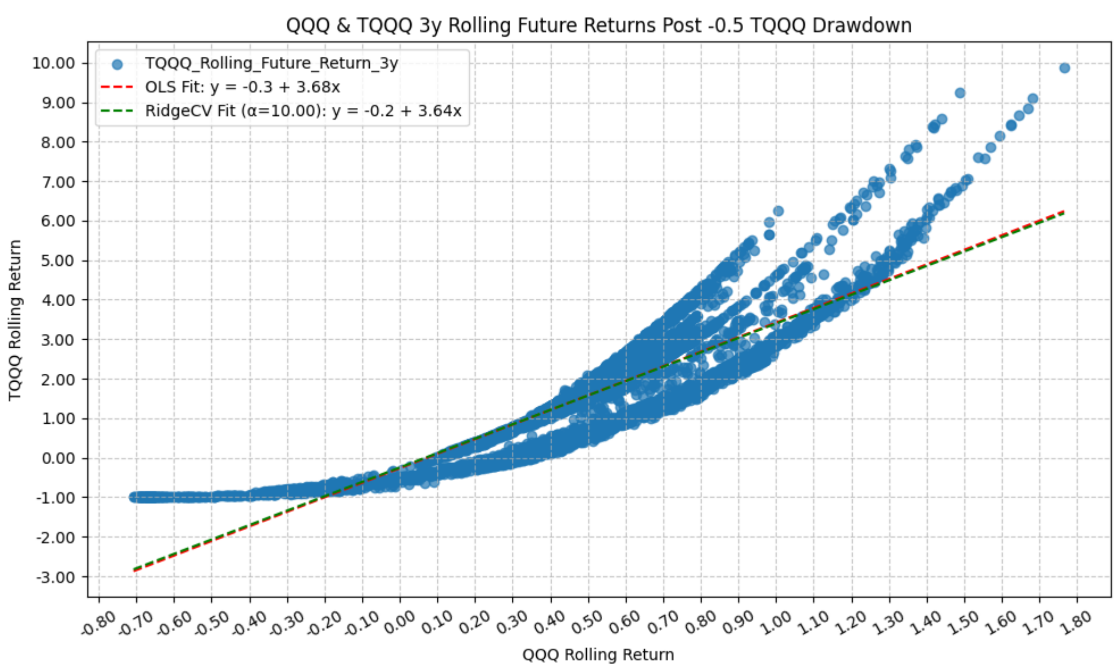





```
                                    OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_2y   R-squared:
```

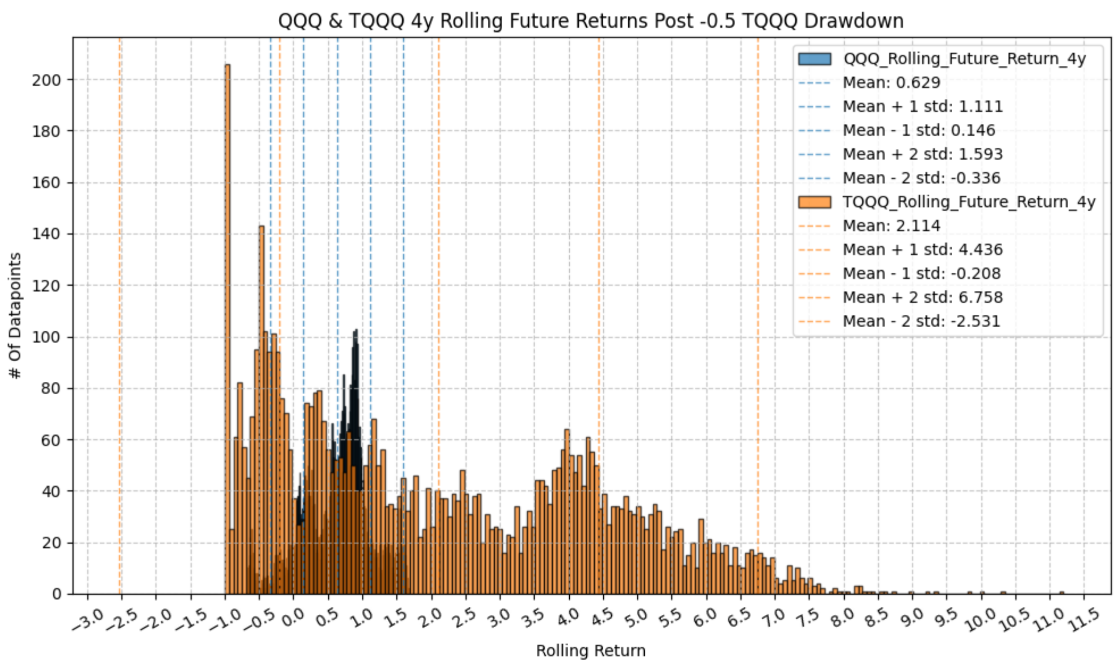
```
0.847
Model:                                    OLS   Adj. R-squared:
0.847
Method:                         Least Squares   F-statistic:
3.336e+04
Date:                        Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                14:27:10   Log-Likelihood:
-4114.4
No. Observations:                        6014   AIC:
8233.
Df Residuals:                            6012   BIC:
8246.
Df Model:                                   1
Covariance Type:                    nonrobust
================================================================================
================
                                coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                        -0.0360      0.008     -4.571      0.000
-0.051      -0.021
QQQ_Rolling_Future_Return_2y     3.2475      0.018    182.648      0.000
3.213       3.282
==============================================================================
Omnibus:                     1717.522   Durbin-Watson:                   0.018
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             5077.382
Skew:                           1.483   Prob(JB):                         0.00
Kurtosis:                       6.386   Cond. No.                         3.12
==============================================================================

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

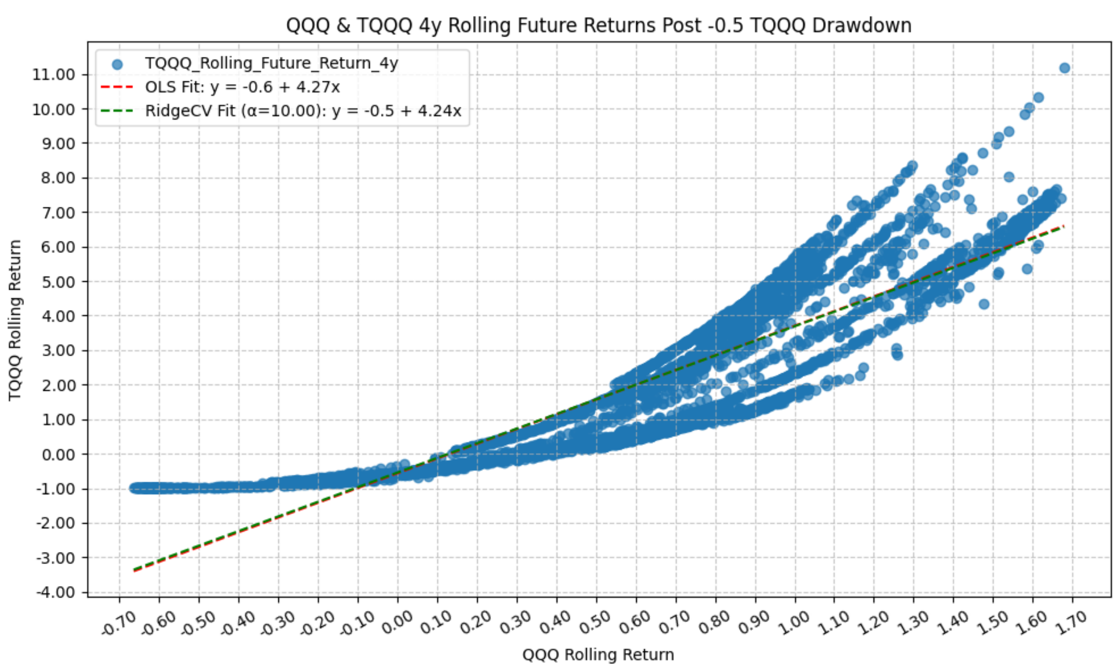





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3y   R-squared:
```

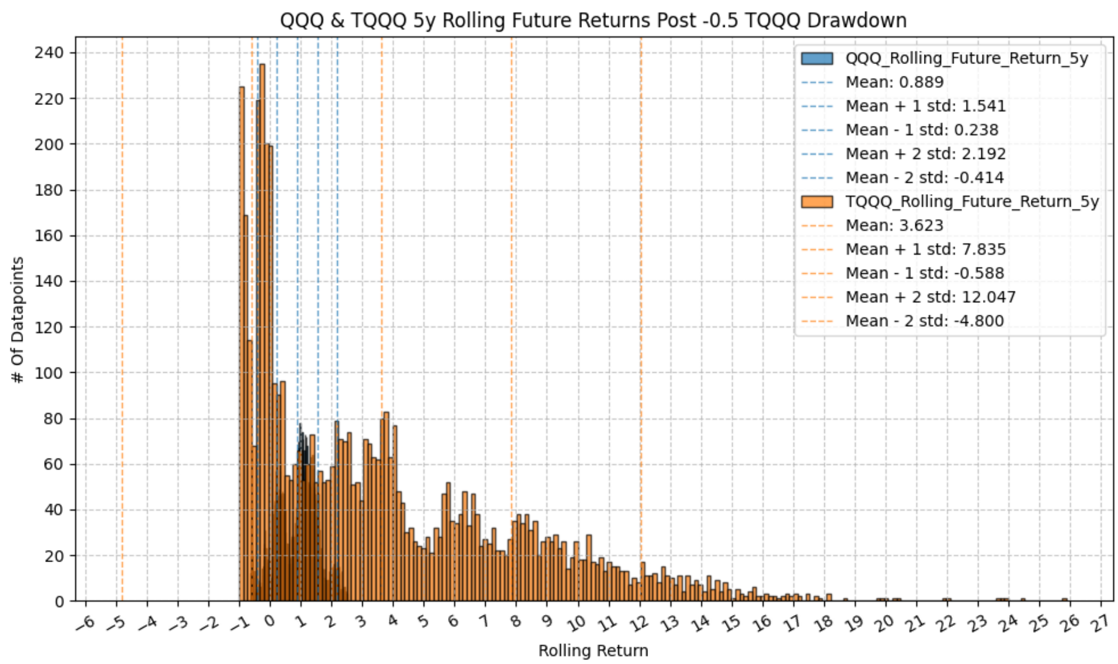
```
0.818
Model:                                    OLS   Adj. R-squared:
0.818
Method:                         Least Squares   F-statistic:
2.588e+04
Date:                        Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                14:27:11   Log-Likelihood:
-6046.1
No. Observations:                        5762   AIC:
1.210e+04
Df Residuals:                            5760   BIC:
1.211e+04
Df Model:                                   1
Covariance Type:                    nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.2659      0.014    -19.547      0.000
-0.293      -0.239
QQQ_Rolling_Future_Return_3y    3.6838      0.023    160.873      0.000
3.639       3.729
==============================================================================
Omnibus:                      866.163   Durbin-Watson:                   0.015
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1580.248
Skew:                           0.959   Prob(JB):                         0.00
Kurtosis:                       4.704   Cond. No.                         3.08
==============================================================================

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

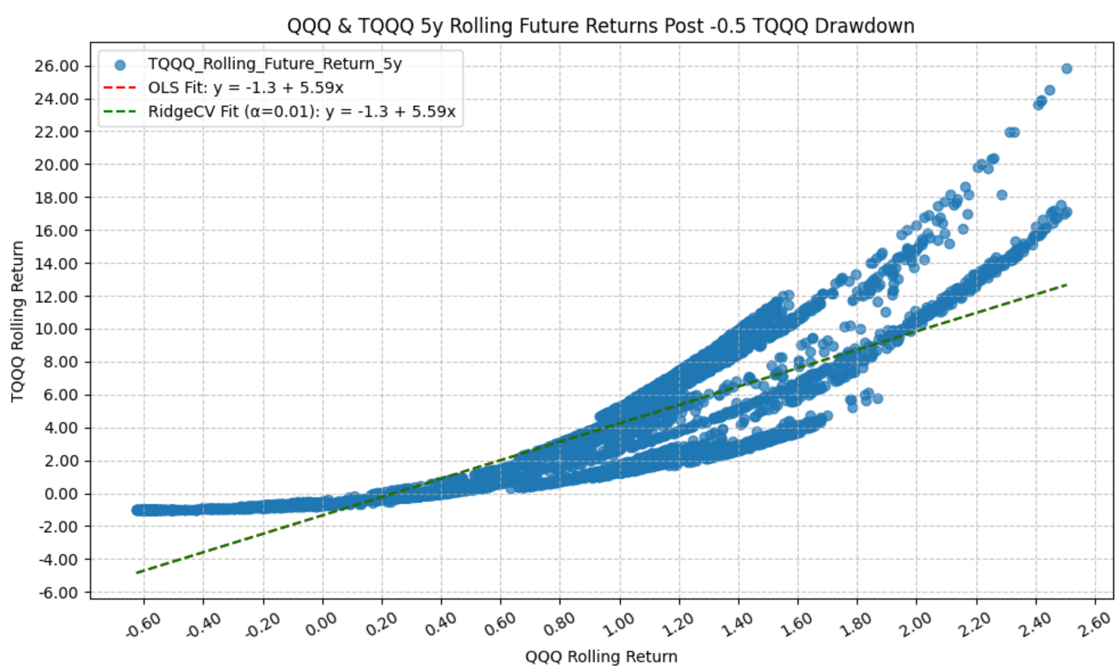





```
                              OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_4y   R-squared:
```

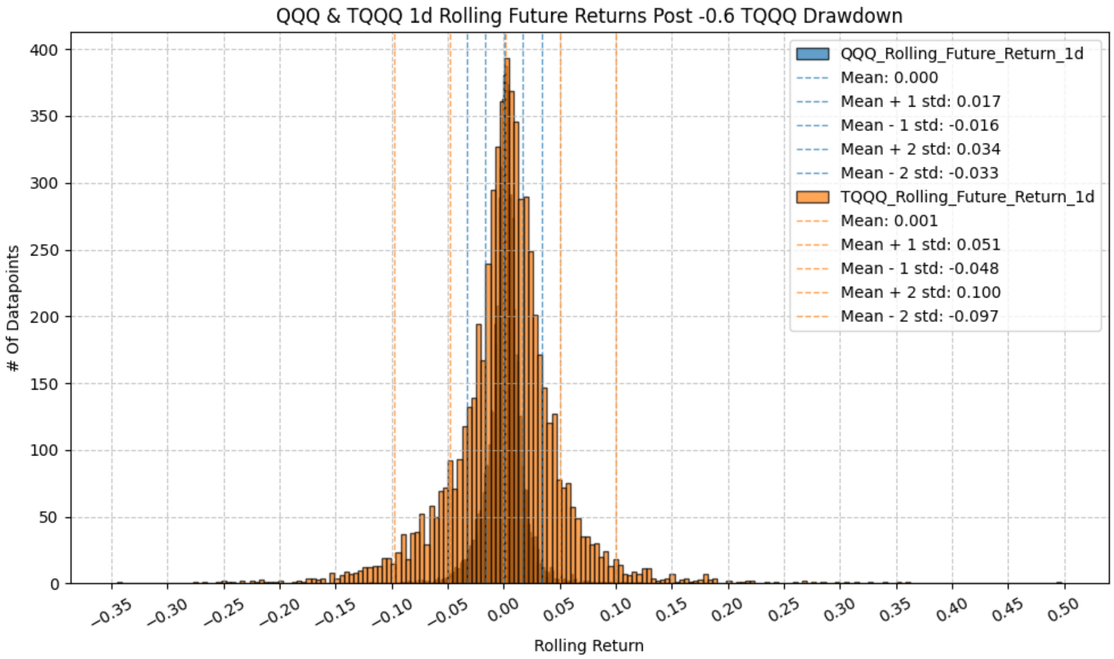
```
0.786
Model:                                 OLS   Adj. R-squared:
0.786
Method:                      Least Squares   F-statistic:
2.021e+04
Date:                     Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                             14:27:12   Log-Likelihood:
-8214.5
No. Observations:                     5510   AIC:
1.643e+04
Df Residuals:                         5508   BIC:
1.645e+04
Df Model:                                1
Covariance Type:                 nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.5696      0.024    -23.943      0.000
-0.616      -0.523
QQQ_Rolling_Future_Return_4y    4.2692      0.030    142.161      0.000
4.210       4.328
==============================================================================
Omnibus:                       65.711   Durbin-Watson:                   0.010
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               51.050
Skew:                           0.151   Prob(JB):                     8.22e-12
Kurtosis:                       2.638   Cond. No.                         3.05
==============================================================================

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

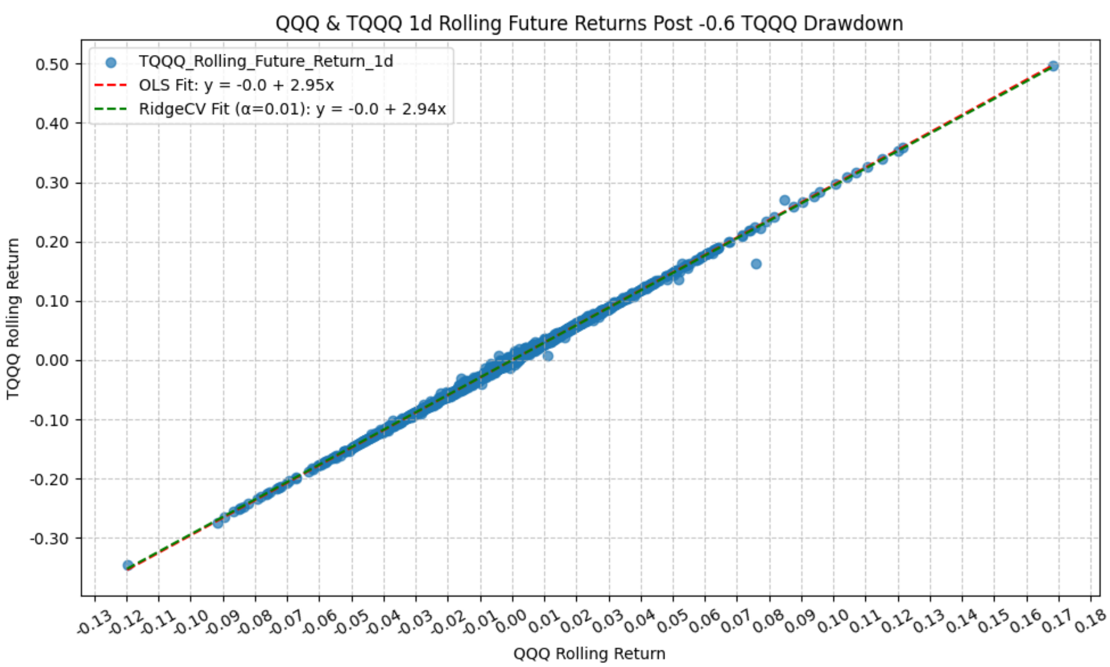





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_5y   R-squared:
```

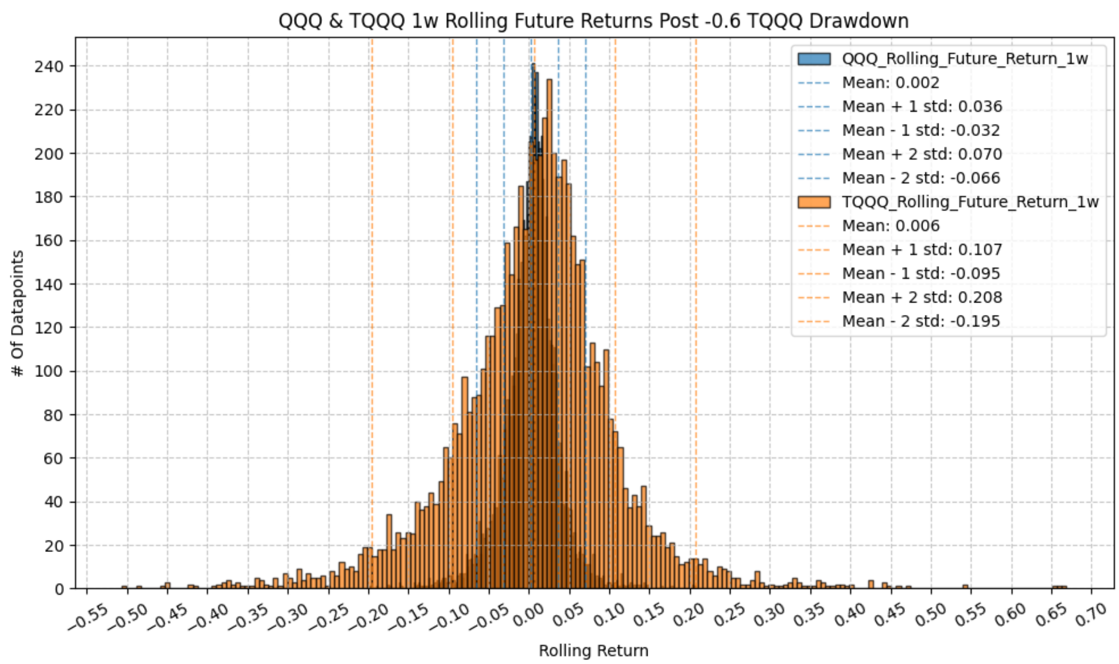
```
0.748
Model:                            OLS   Adj. R-squared:
0.748
Method:                 Least Squares   F-statistic:
1.563e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:13   Log-Likelihood:
-11393.
No. Observations:                5258   AIC:
2.279e+04
Df Residuals:                    5256   BIC:
2.280e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                               coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                       -1.3493      0.049    -27.365      0.000
-1.446      -1.253
QQQ_Rolling_Future_Return_5y  5.5930      0.045    125.018      0.000
5.505       5.681
==============================================================================
Omnibus:                      239.977   Durbin-Watson:                   0.009
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              361.637
Skew:                           0.414   Prob(JB):                     2.96e-79
Kurtosis:                       3.982   Cond. No.                         3.08
==============================================================================

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

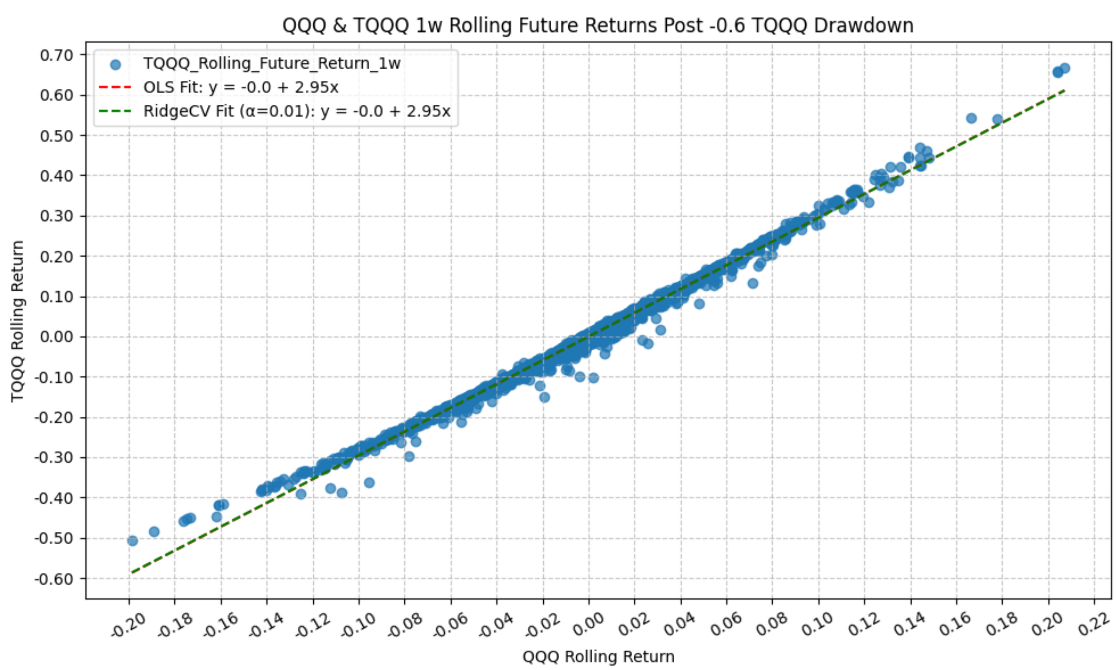





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1d   R-squared:
```

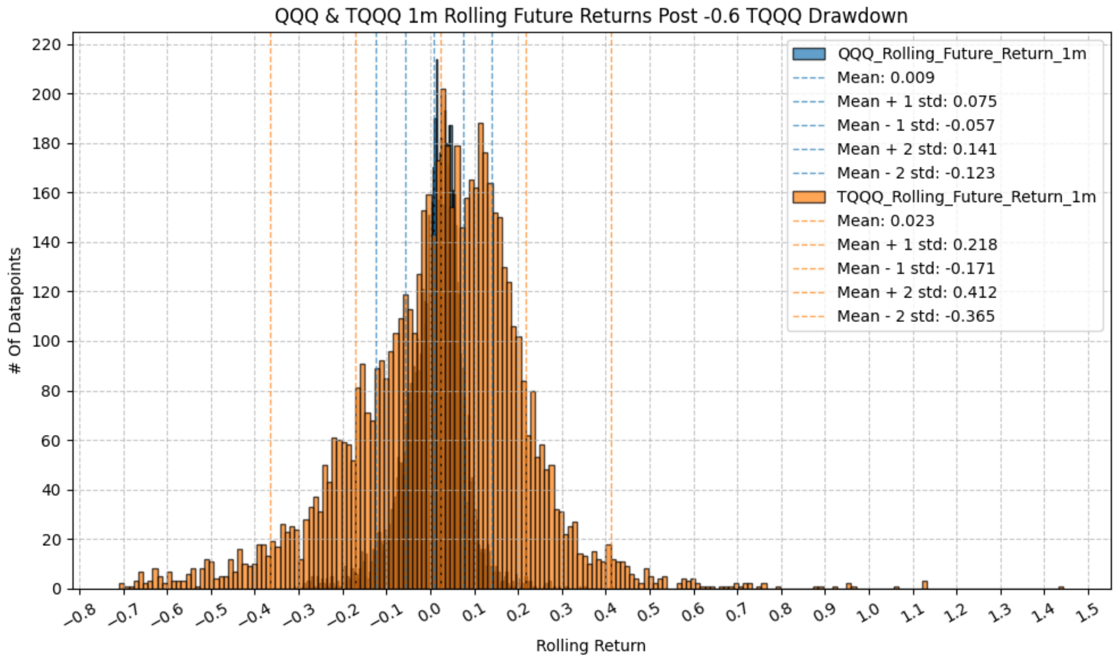
```
0.999
Model:                                OLS   Adj. R-squared:
0.999
Method:                     Least Squares   F-statistic:
5.999e+06
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:27:15   Log-Likelihood:
31532.
No. Observations:                    6280   AIC:
-6.306e+04
Df Residuals:                        6278   BIC:
-6.305e+04
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                       -4.232e-05   2.02e-05     -2.100      0.036
-8.18e-05   -2.81e-06
QQQ_Rolling_Future_Return_1d     2.9547      0.001   2449.263      0.000
2.952       2.957
==============================================================================
Omnibus:                     9286.532   Durbin-Watson:                   2.569
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         35696636.910
Skew:                          -8.058   Prob(JB):                         0.00
Kurtosis:                     371.999   Cond. No.                         59.9
==============================================================================

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

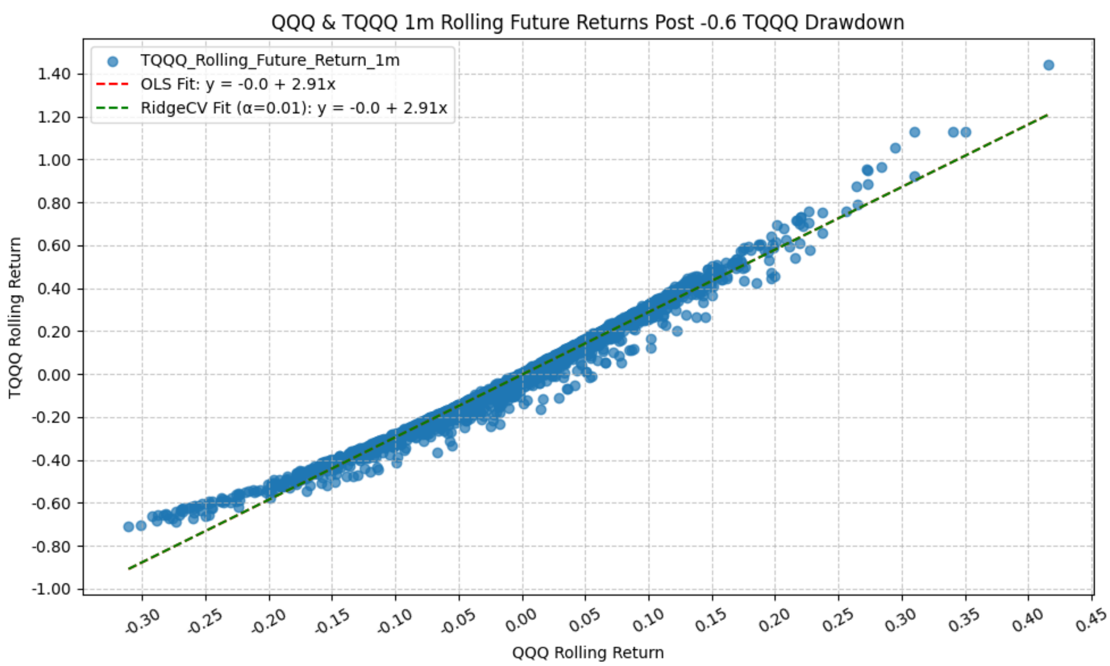





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1w   R-squared:
```

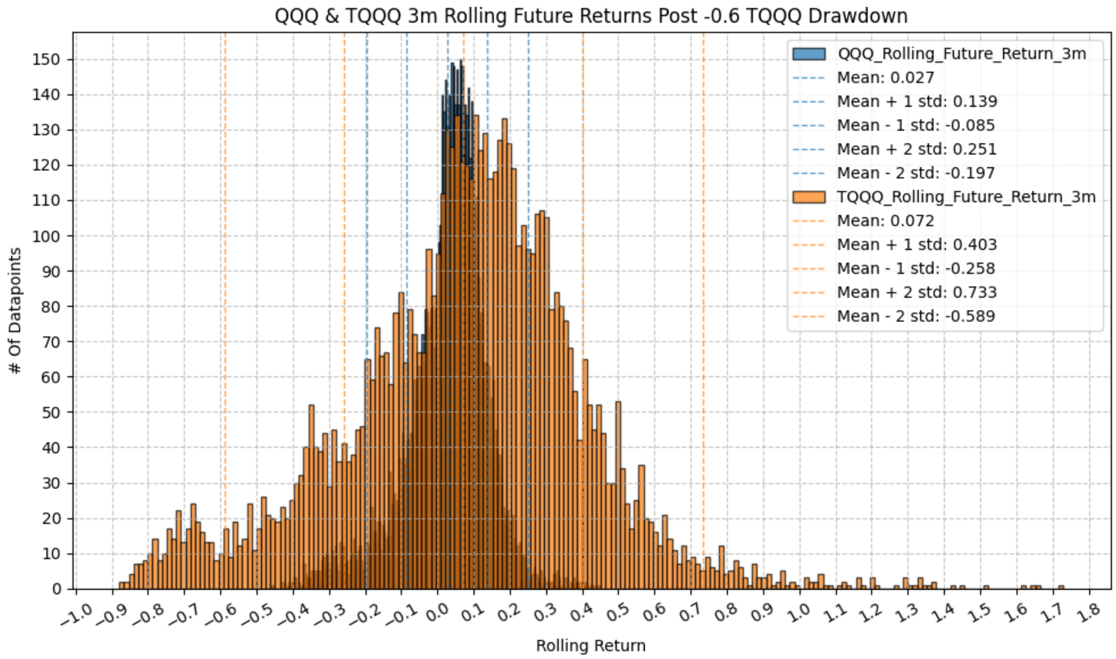
```
0.994
Model:                            OLS   Adj. R-squared:
0.994
Method:                 Least Squares   F-statistic:
1.076e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:16   Log-Likelihood:
21675.
No. Observations:                6280   AIC:
-4.335e+04
Df Residuals:                    6278   BIC:
-4.333e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0007    9.7e-05     -7.551      0.000
-0.001      -0.001
QQQ_Rolling_Future_Return_1w   2.9525      0.003   1037.392      0.000
2.947       2.958
==============================================================================
Omnibus:                     3408.626   Durbin-Watson:                   0.895
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           384667.664
Skew:                          -1.639   Prob(JB):                         0.00
Kurtosis:                      41.201   Cond. No.                         29.4
==============================================================================

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

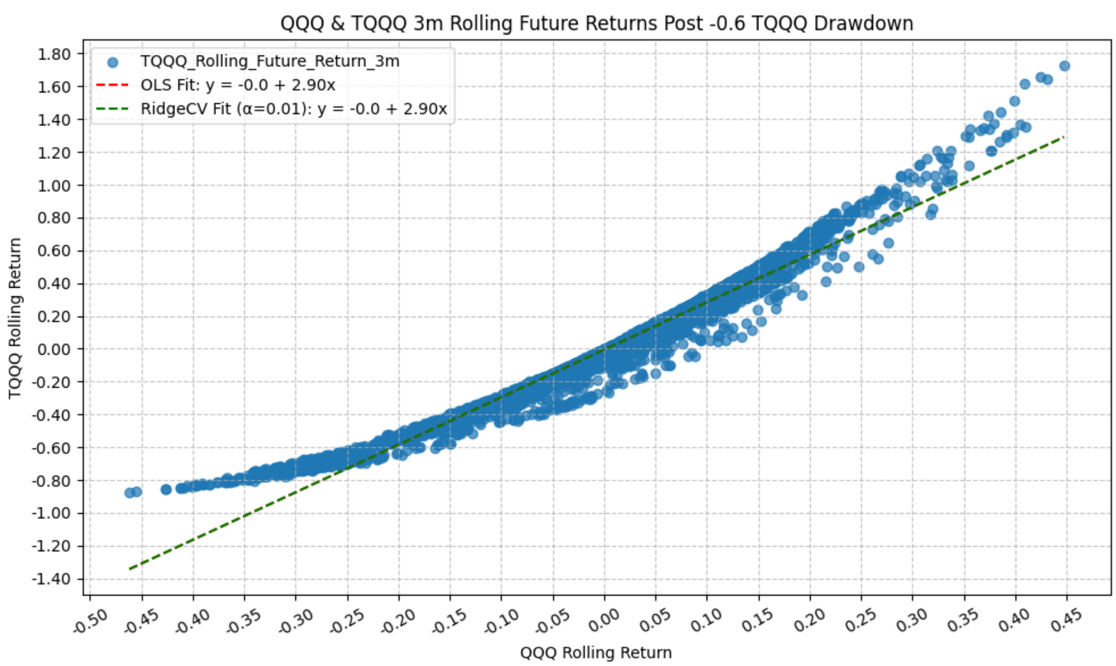





```
                           OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_1m   R-squared:
```

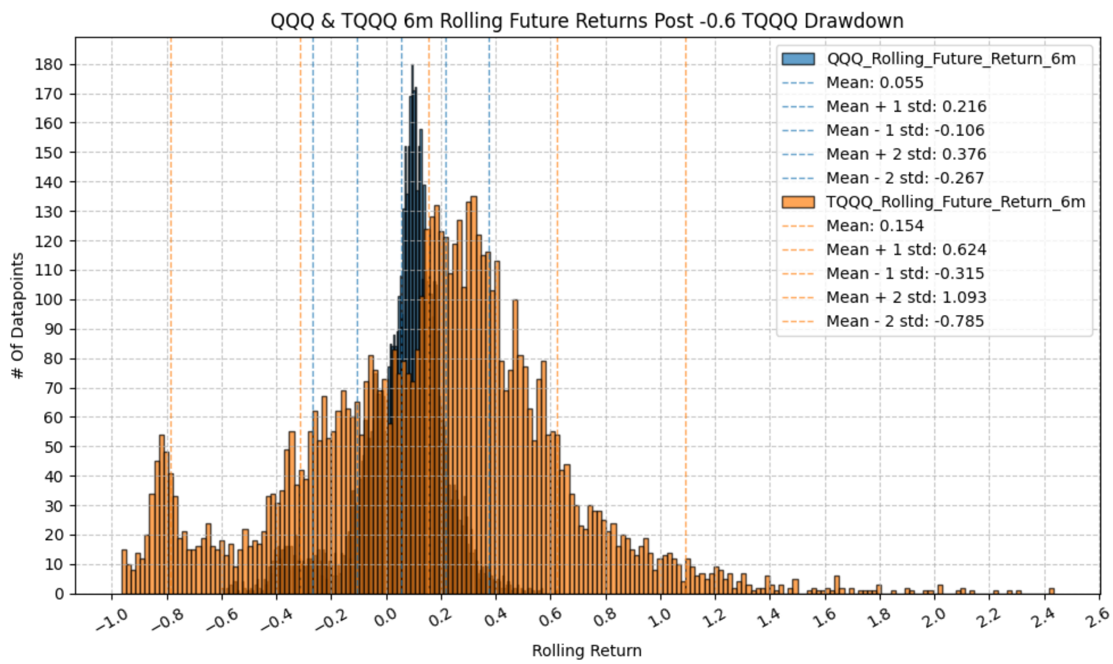
```
0.982
Model:                                OLS   Adj. R-squared:
0.982
Method:                     Least Squares   F-statistic:
3.507e+05
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:27:17   Log-Likelihood:
14068.
No. Observations:                    6280   AIC:
-2.813e+04
Df Residuals:                        6278   BIC:
-2.812e+04
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0032      0.000     -9.790      0.000
-0.004      -0.003
QQQ_Rolling_Future_Return_1m     2.9140      0.005    592.182      0.000
2.904       2.924
==============================================================================
Omnibus:                     1452.365   Durbin-Watson:                   0.296
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            78369.604
Skew:                           0.053   Prob(JB):                         0.00
Kurtosis:                      20.306   Cond. No.                         15.1
==============================================================================

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

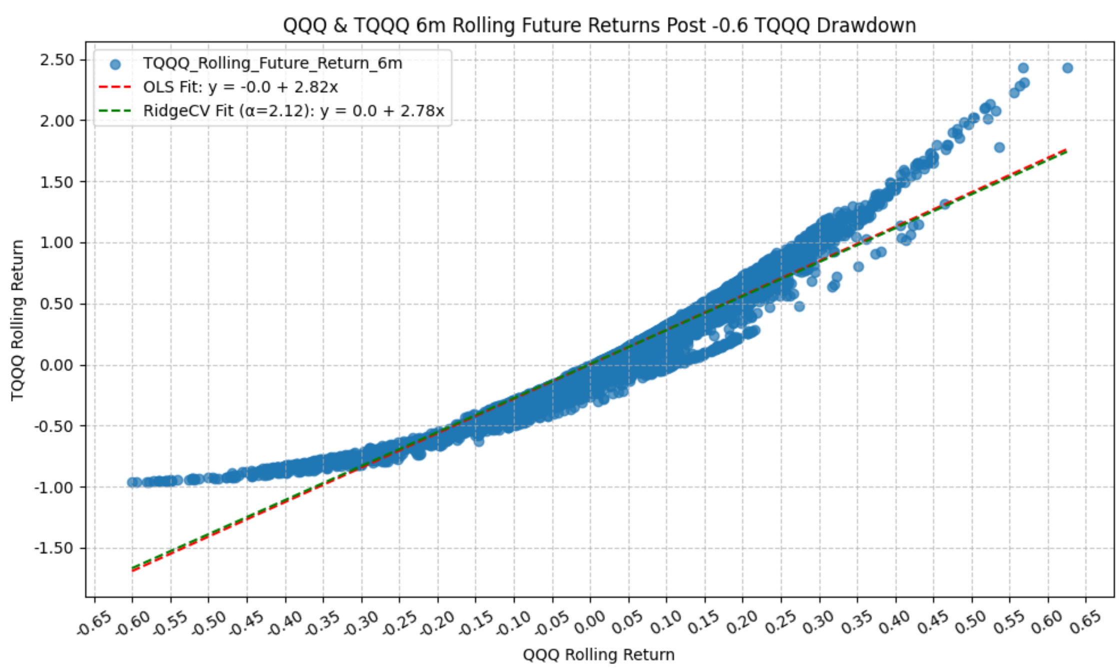





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3m   R-squared:
```

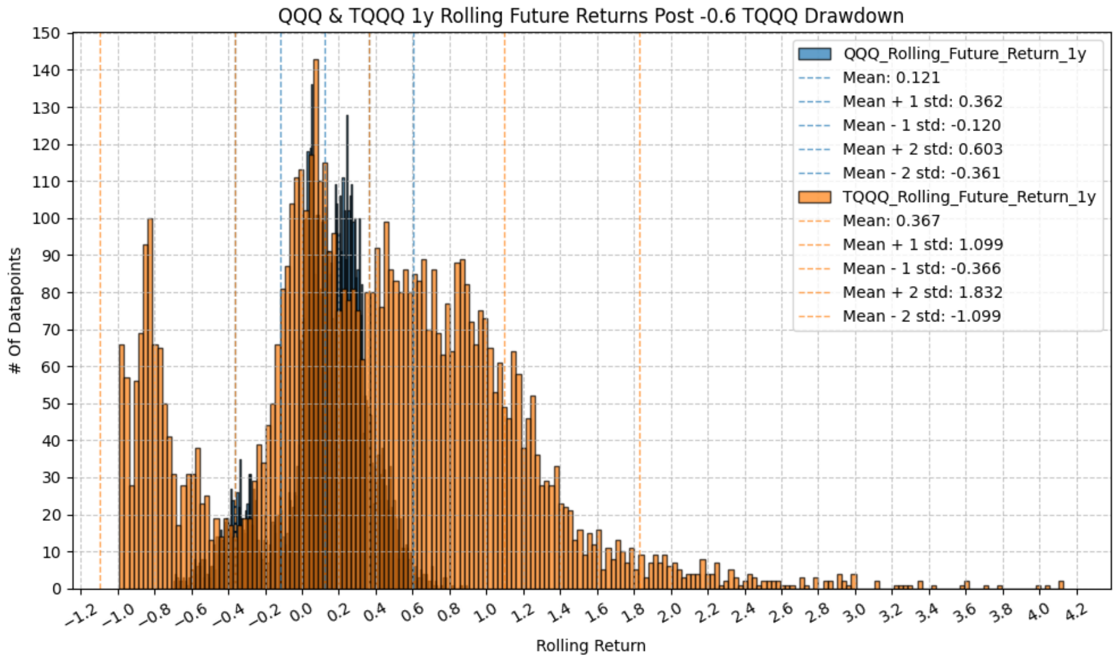
```
0.961
Model:                            OLS   Adj. R-squared:
0.961
Method:                 Least Squares   F-statistic:
1.566e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:18   Log-Likelihood:
8264.2
No. Observations:                6280   AIC:
-1.652e+04
Df Residuals:                    6278   BIC:
-1.651e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0059      0.001     -7.038      0.000
-0.008      -0.004
QQQ_Rolling_Future_Return_3m   2.8977      0.007    395.692      0.000
2.883       2.912
==============================================================================
Omnibus:                     1352.162   Durbin-Watson:                   0.102
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            15599.280
Skew:                           0.696   Prob(JB):                         0.00
Kurtosis:                      10.594   Cond. No.                         8.95
==============================================================================

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

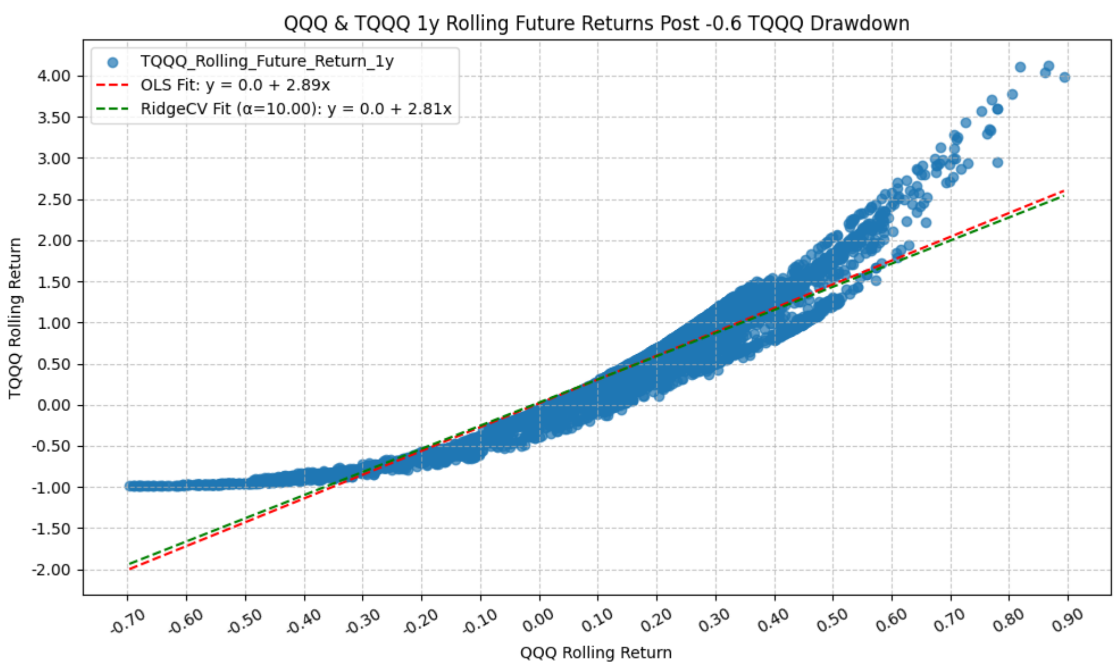





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_6m   R-squared:
```

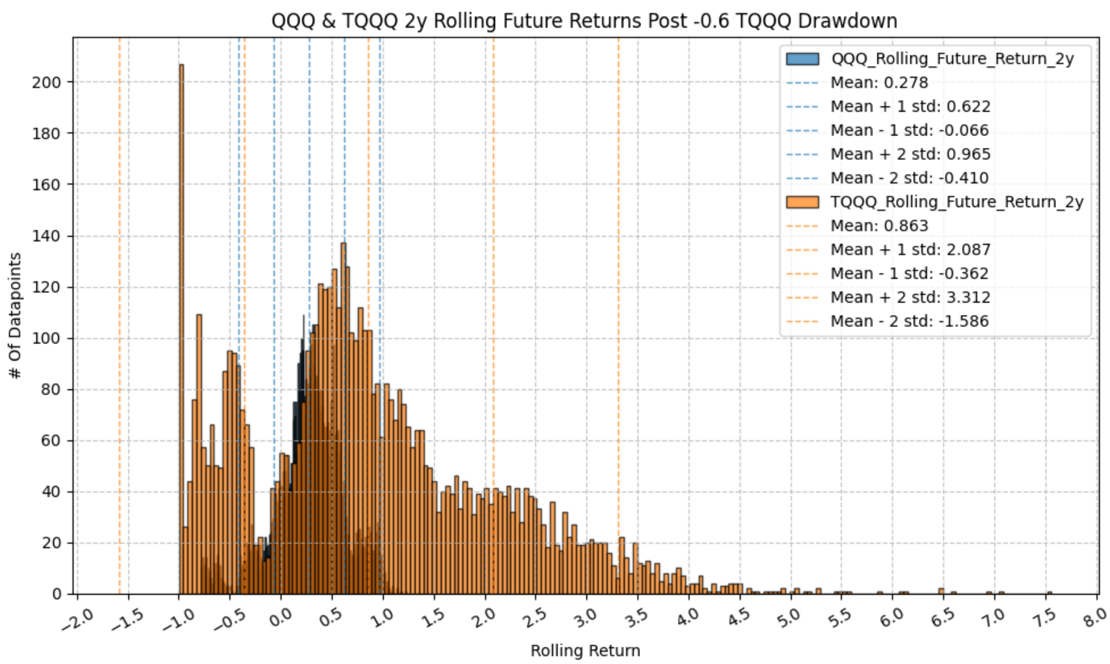
```
0.932
Model:                            OLS   Adj. R-squared:
0.932
Method:                 Least Squares   F-statistic:
8.613e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:19   Log-Likelihood:
4282.1
No. Observations:                6280   AIC:
-8560.
Df Residuals:                    6278   BIC:
-8547.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0002      0.002     -0.127      0.899
-0.003       0.003
QQQ_Rolling_Future_Return_6m    2.8191      0.010    293.486      0.000
2.800       2.838
==============================================================================
Omnibus:                     1637.681   Durbin-Watson:                   0.057
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8395.060
Skew:                           1.159   Prob(JB):                         0.00
Kurtosis:                       8.168   Cond. No.                         6.24
==============================================================================

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

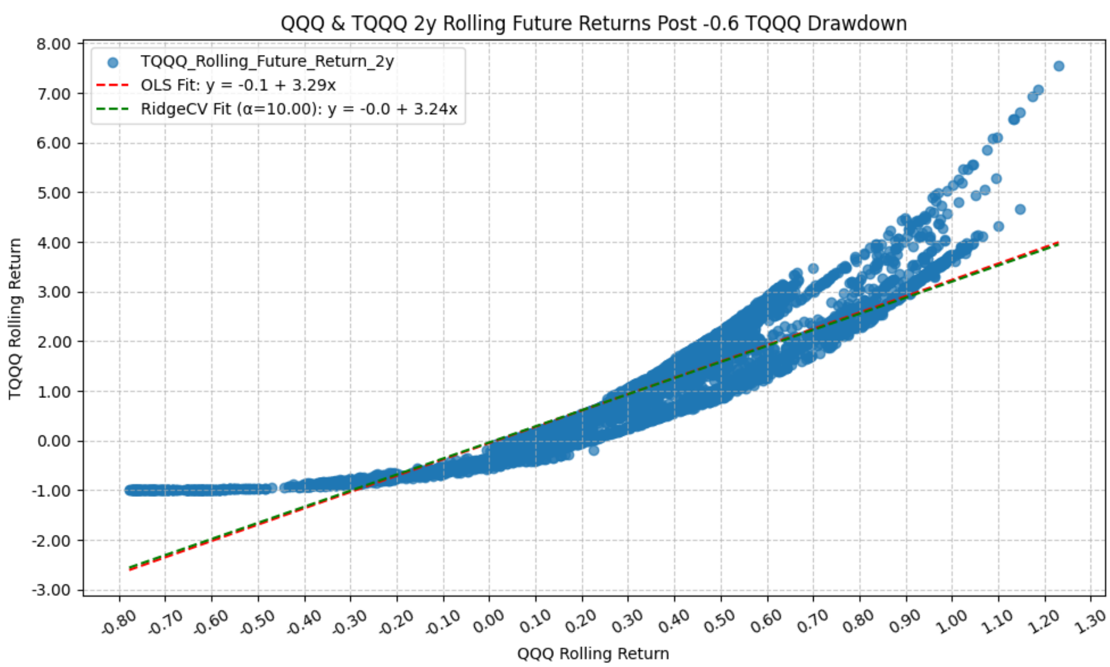





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1y   R-squared:
```

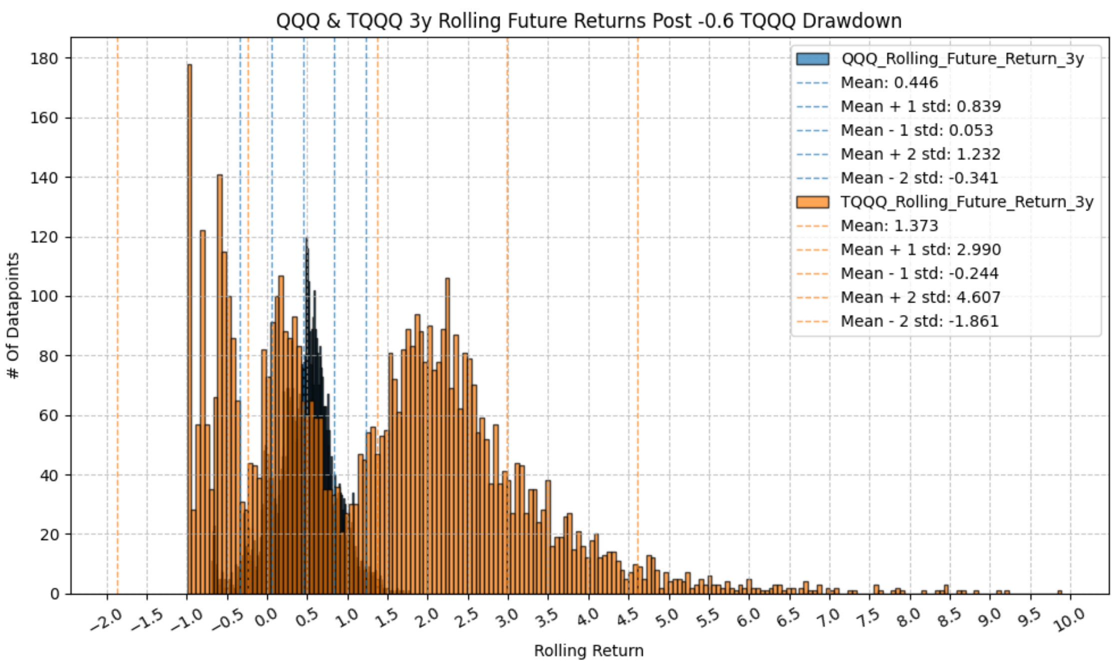
```
0.904
Model:                            OLS   Adj. R-squared:
0.904
Method:                 Least Squares   F-statistic:
5.852e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:20   Log-Likelihood:
404.91
No. Observations:                6199   AIC:
-805.8
Df Residuals:                    6197   BIC:
-792.3
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           0.0162      0.003      5.033      0.000
0.010       0.023
QQQ_Rolling_Future_Return_1y    2.8920      0.012    241.905      0.000
2.869       2.915
==============================================================================
Omnibus:                     1966.648   Durbin-Watson:                   0.038
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8739.805
Skew:                           1.487   Prob(JB):                         0.00
Kurtosis:                       7.999   Cond. No.                         4.22
==============================================================================

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

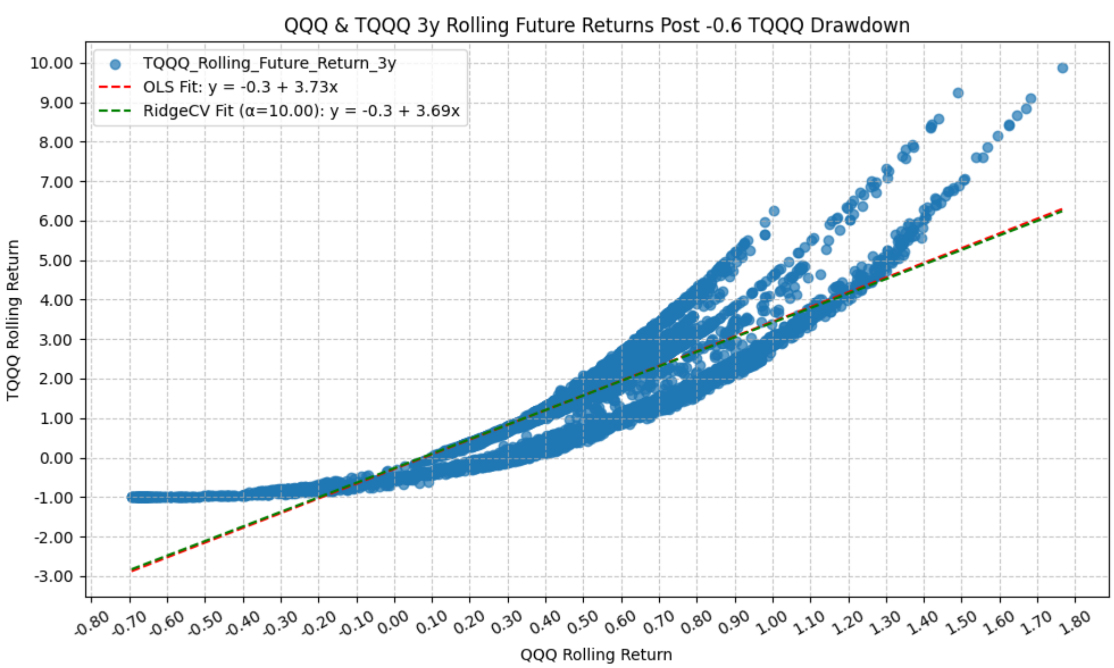





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_2y   R-squared:
```

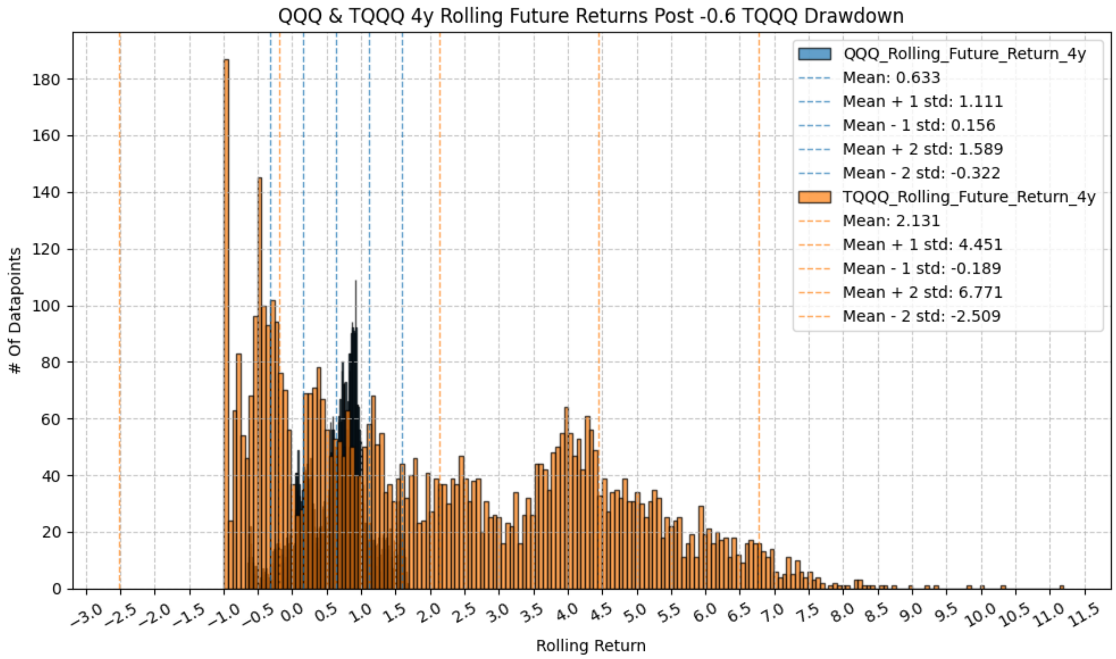
```
0.851
Model:                            OLS   Adj. R-squared:
0.851
Method:                 Least Squares   F-statistic:
3.401e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:22   Log-Likelihood:
-4010.4
No. Observations:                5977   AIC:
8025.
Df Residuals:                    5975   BIC:
8038.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0503      0.008     -6.388      0.000
-0.066      -0.035
QQQ_Rolling_Future_Return_2y   3.2857      0.018    184.405      0.000
3.251       3.321
==============================================================================
Omnibus:                     1728.061   Durbin-Watson:                   0.019
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             5277.259
Skew:                           1.488   Prob(JB):                         0.00
Kurtosis:                       6.512   Cond. No.                         3.16
==============================================================================

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

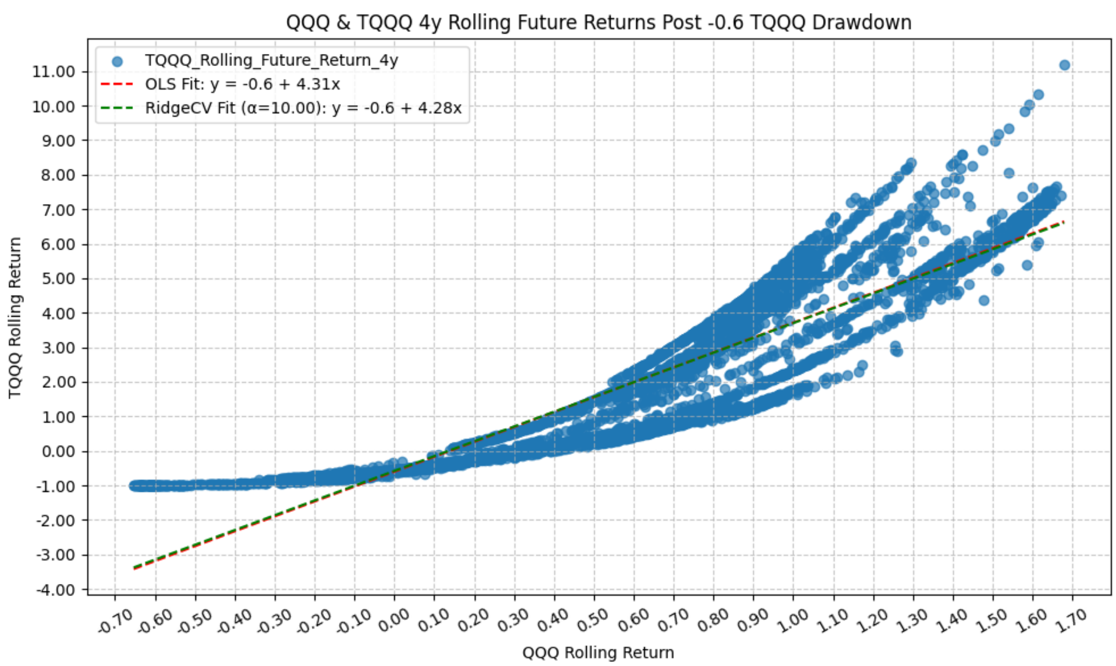





```
                           OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3y   R-squared:
```

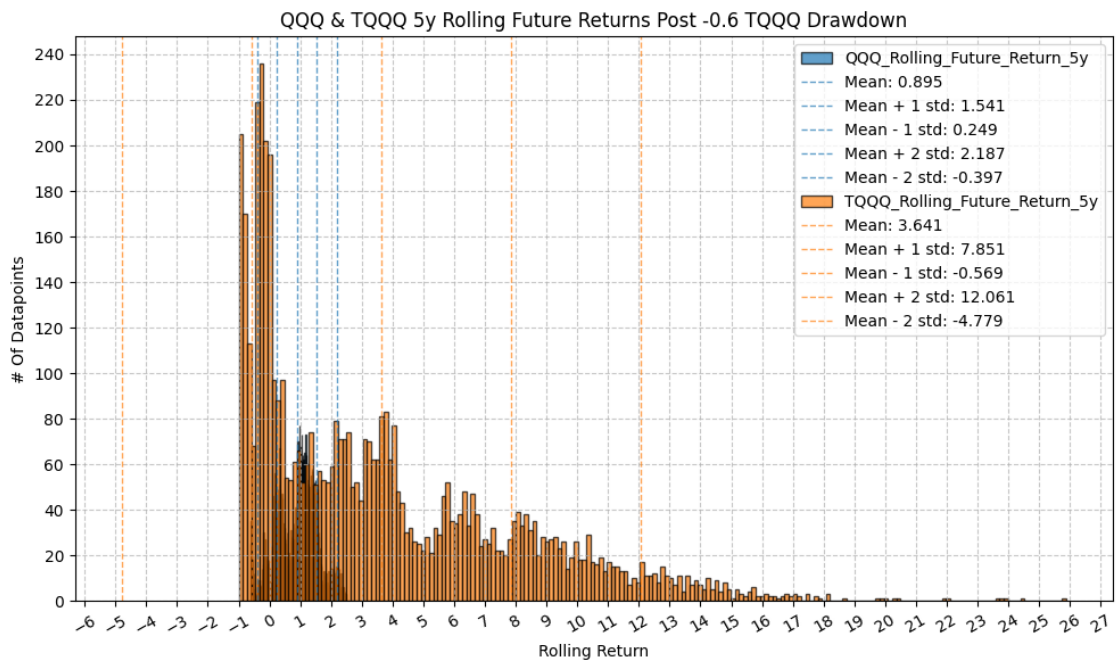
```
0.821
Model:                            OLS   Adj. R-squared:
0.821
Method:                 Least Squares   F-statistic:
2.631e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:23   Log-Likelihood:
-5943.8
No. Observations:                5725   AIC:
1.189e+04
Df Residuals:                    5723   BIC:
1.190e+04
Df Model:                           1
Covariance Type:            nonrobust
===============================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
-------------------------------------------------------------------------------
----------------
const                         -0.2891      0.014    -21.164      0.000
-0.316      -0.262
QQQ_Rolling_Future_Return_3y   3.7271      0.023    162.217      0.000
3.682       3.772
==============================================================================
Omnibus:                      846.190   Durbin-Watson:                   0.015
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1556.288
Skew:                           0.941   Prob(JB):                         0.00
Kurtosis:                       4.726   Cond. No.                         3.12
==============================================================================

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

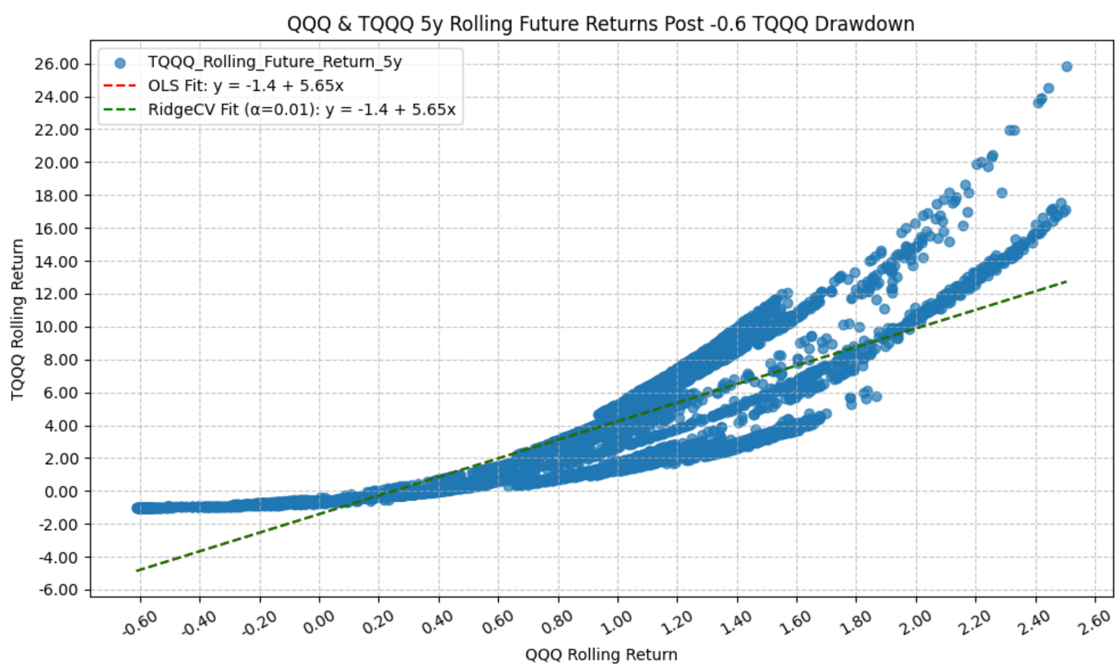





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_4y   R-squared:
```

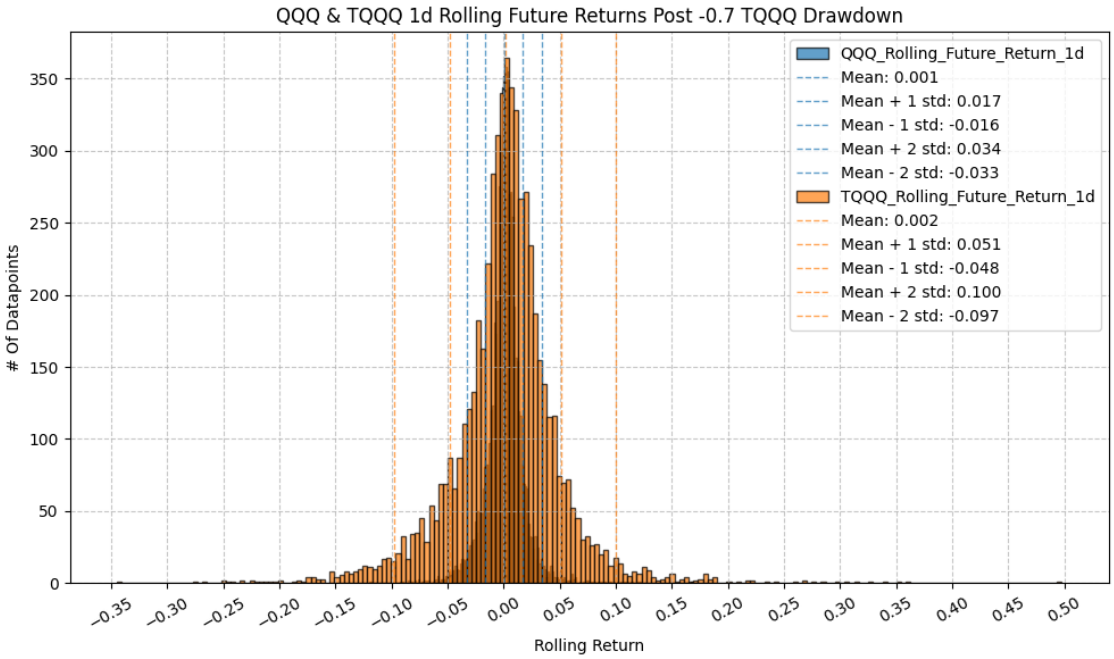
```
0.789
Model:                            OLS   Adj. R-squared:
0.789
Method:                 Least Squares   F-statistic:
2.045e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:24   Log-Likelihood:
-8114.6
No. Observations:                5473   AIC:
1.623e+04
Df Residuals:                    5471   BIC:
1.625e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.6018      0.024    -25.144      0.000
-0.649      -0.555
QQQ_Rolling_Future_Return_4y    4.3140      0.030    142.997      0.000
4.255       4.373
==============================================================================
Omnibus:                       51.316   Durbin-Watson:                   0.010
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               40.579
Skew:                           0.131   Prob(JB):                     1.54e-09
Kurtosis:                       2.669   Cond. No.                         3.09
==============================================================================

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

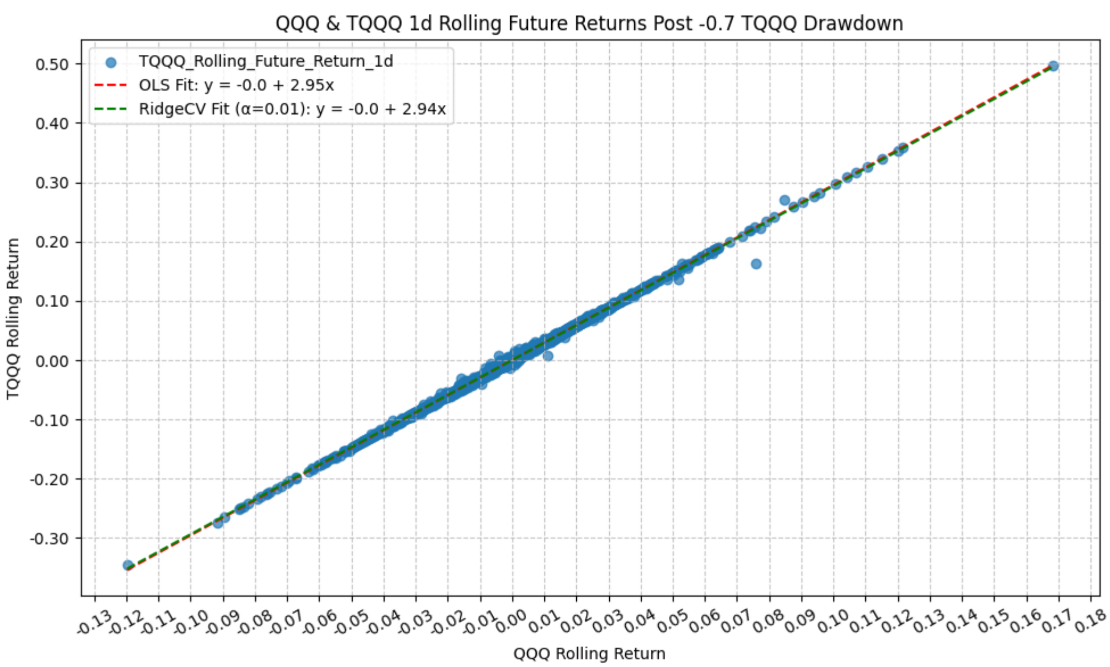





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_5y   R-squared:
```

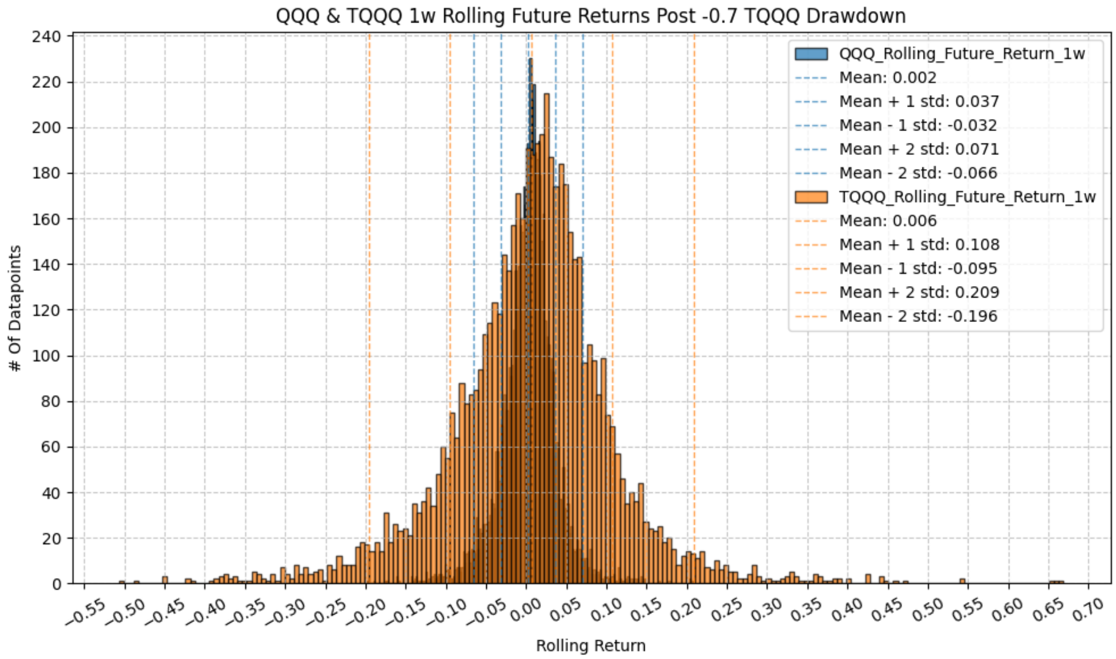
```
0.750
Model:                            OLS   Adj. R-squared:
0.750
Method:                 Least Squares   F-statistic:
1.574e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:25   Log-Likelihood:
-11327.
No. Observations:                5238   AIC:
2.266e+04
Df Residuals:                    5236   BIC:
2.267e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -1.4104      0.050    -28.398      0.000
-1.508      -1.313
QQQ_Rolling_Future_Return_5y   5.6451      0.045    125.443      0.000
5.557       5.733
==============================================================================
Omnibus:                      226.987   Durbin-Watson:                   0.009
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              348.438
Skew:                           0.392   Prob(JB):                     2.18e-76
Kurtosis:                       3.990   Cond. No.                         3.11
==============================================================================

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

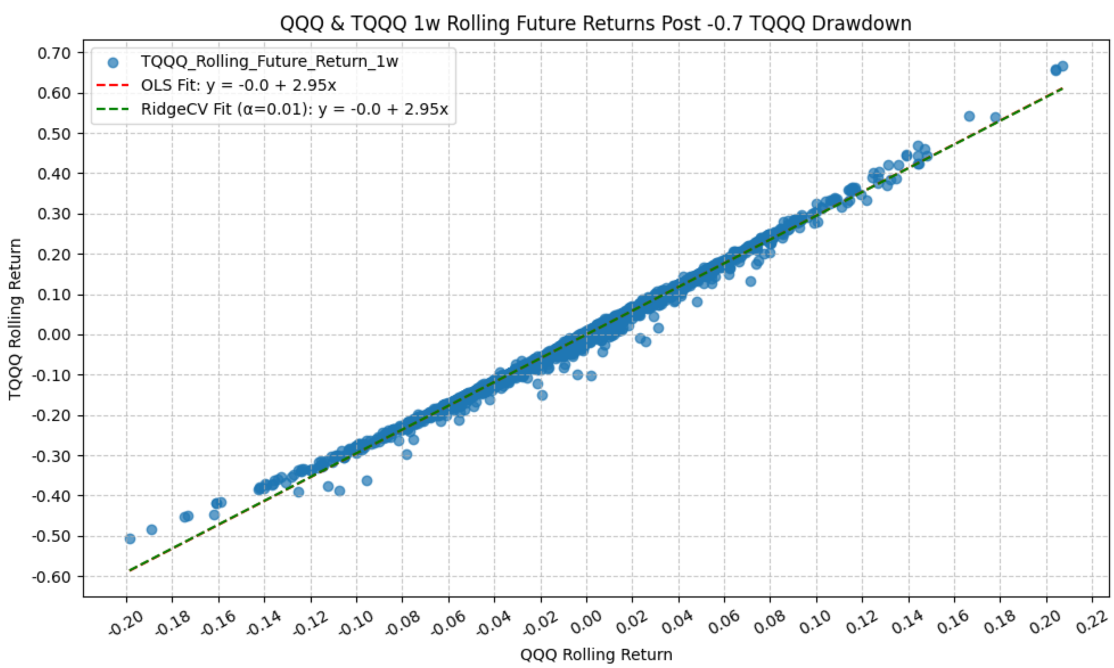





```
                           OLS Regression Results
================================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1d   R-squared:
```

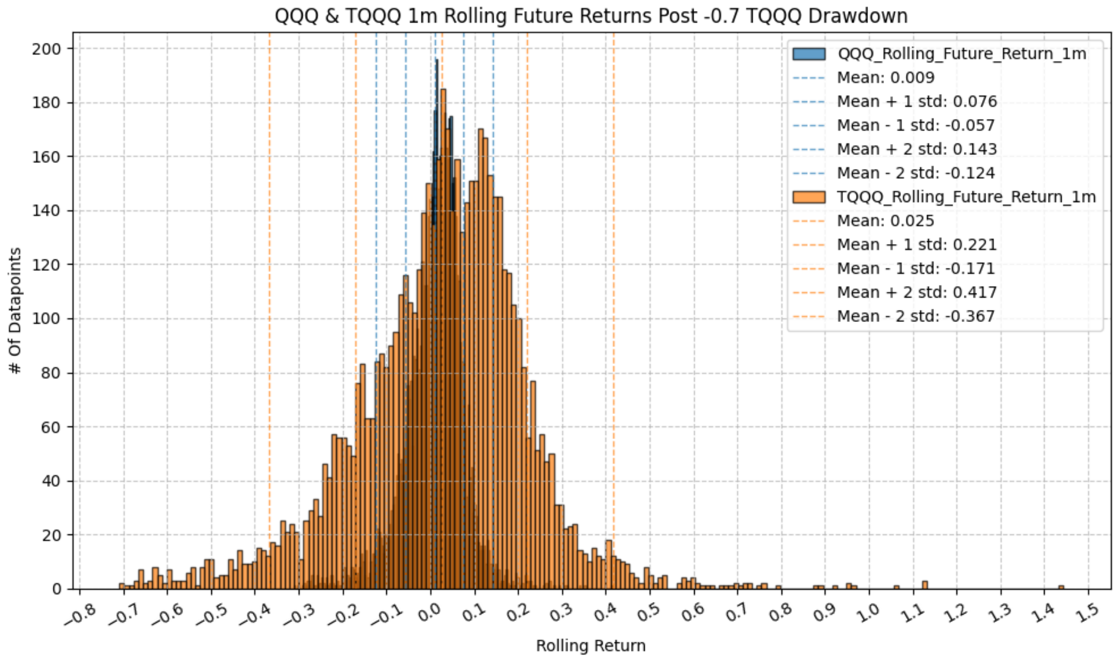
```
0.999
Model:                                OLS   Adj. R-squared:
0.999
Method:                     Least Squares   F-statistic:
5.379e+06
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:27:26   Log-Likelihood:
29443.
No. Observations:                    5890   AIC:
-5.888e+04
Df Residuals:                        5888   BIC:
-5.887e+04
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                      -3.034e-05   2.13e-05     -1.426      0.154
-7.21e-05    1.14e-05
QQQ_Rolling_Future_Return_1d     2.9544      0.001   2319.352      0.000
2.952       2.957
==============================================================================
Omnibus:                     8697.849   Durbin-Watson:                   2.575
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         31773160.847
Skew:                          -8.043   Prob(JB):                         0.00
Kurtosis:                     362.454   Cond. No.                         59.9
==============================================================================

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

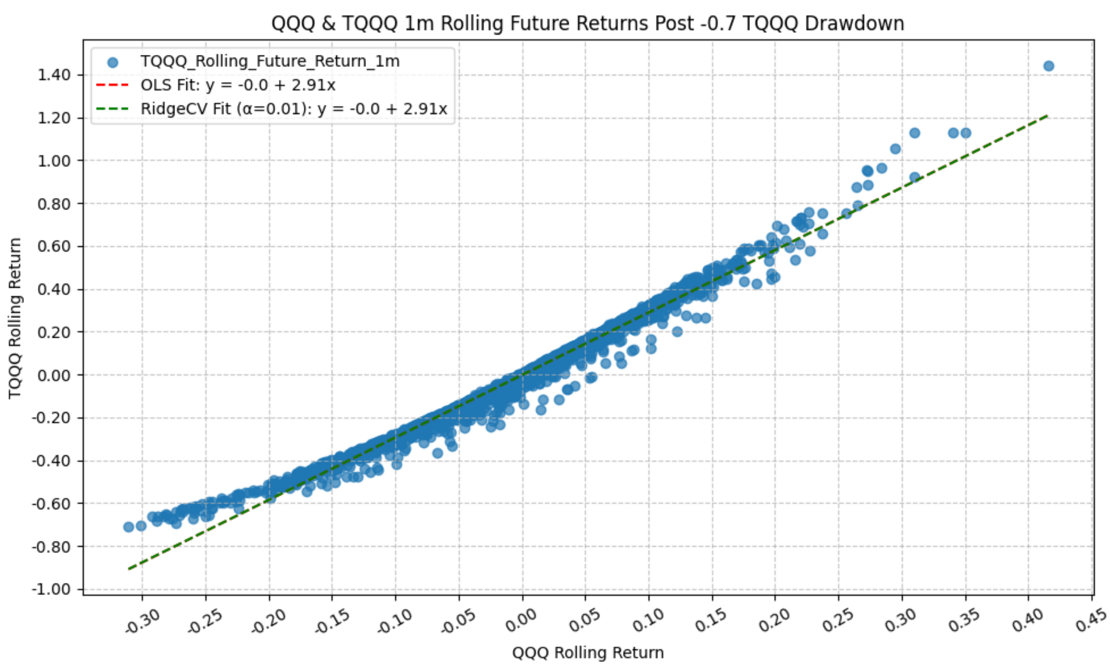





```
                          OLS Regression Results
================================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1w   R-squared:
```

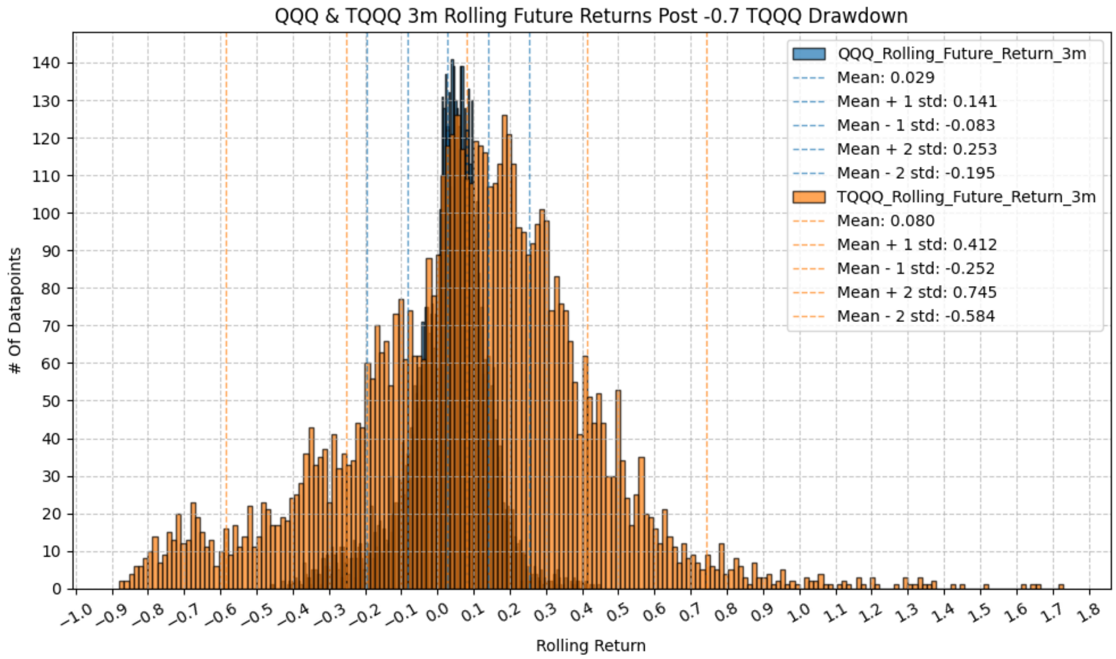
```
0.994
Model:                            OLS   Adj. R-squared:
0.994
Method:                 Least Squares   F-statistic:
1.008e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:27   Log-Likelihood:
20303.
No. Observations:                5890   AIC:
-4.060e+04
Df Residuals:                    5888   BIC:
-4.059e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0006      0.000     -6.361      0.000
-0.001      -0.000
QQQ_Rolling_Future_Return_1w     2.9525      0.003   1003.867      0.000
2.947       2.958
==============================================================================
Omnibus:                     3288.157   Durbin-Watson:                   0.897
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           369121.603
Skew:                          -1.720   Prob(JB):                         0.00
Kurtosis:                      41.629   Cond. No.                         29.3
==============================================================================

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

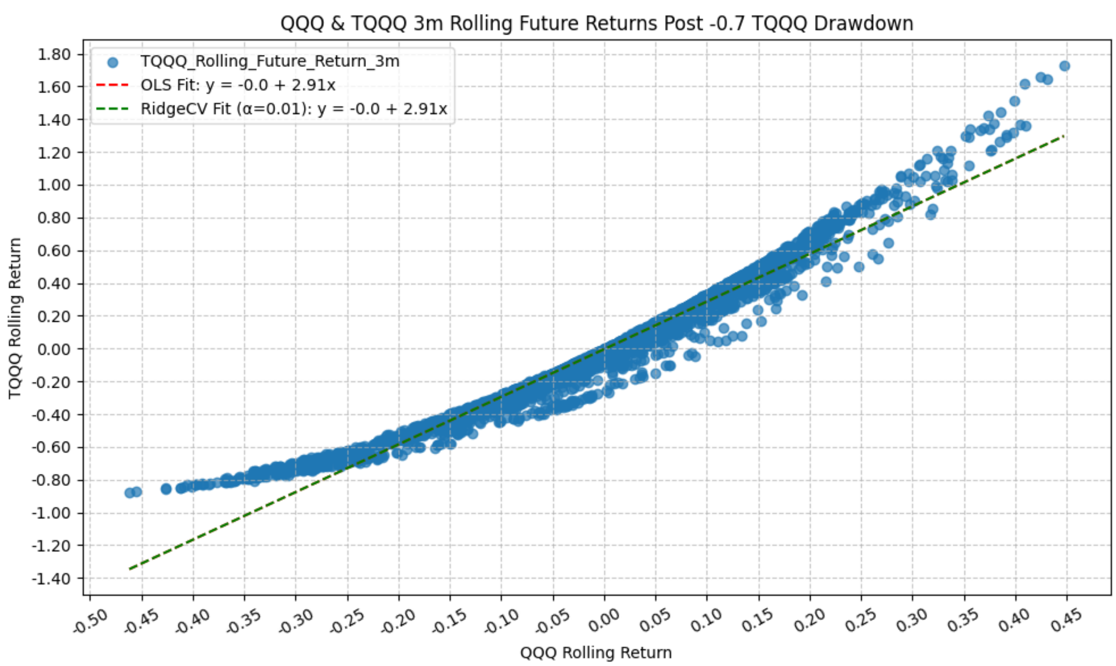





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1m   R-squared:
```

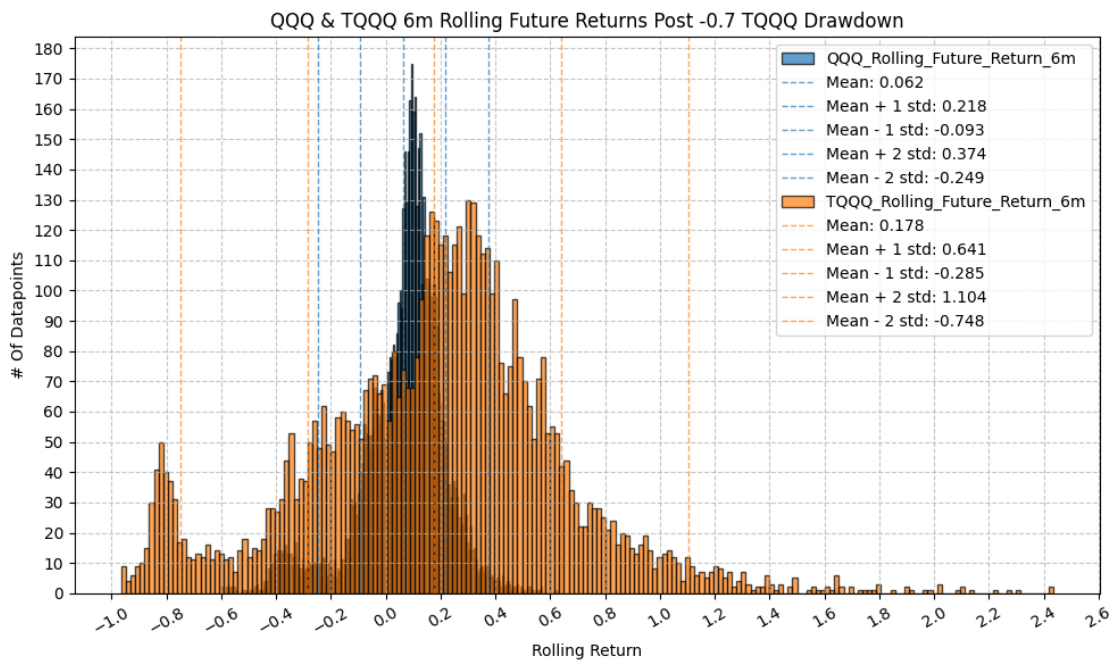
```
0.983
Model:                            OLS   Adj. R-squared:
0.983
Method:                 Least Squares   F-statistic:
3.372e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:29   Log-Likelihood:
13210.
No. Observations:                5890   AIC:
-2.642e+04
Df Residuals:                    5888   BIC:
-2.640e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                               coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                       -0.0025      0.000     -7.377      0.000
-0.003      -0.002
QQQ_Rolling_Future_Return_1m     2.9139      0.005    580.681      0.000
2.904       2.924
==============================================================================
Omnibus:                 1415.259   Durbin-Watson:                   0.310
Prob(Omnibus):              0.000   Jarque-Bera (JB):            78284.153
Skew:                       0.193   Prob(JB):                         0.00
Kurtosis:                  20.856   Cond. No.                         15.0
==============================================================================

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

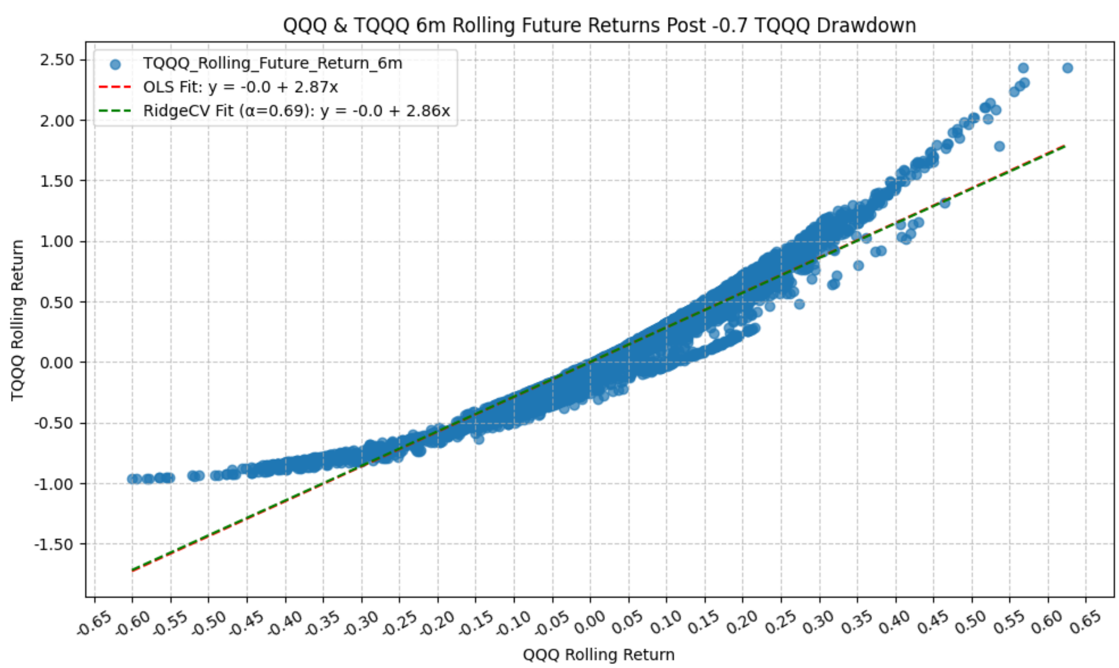





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_3m   R-squared:
```

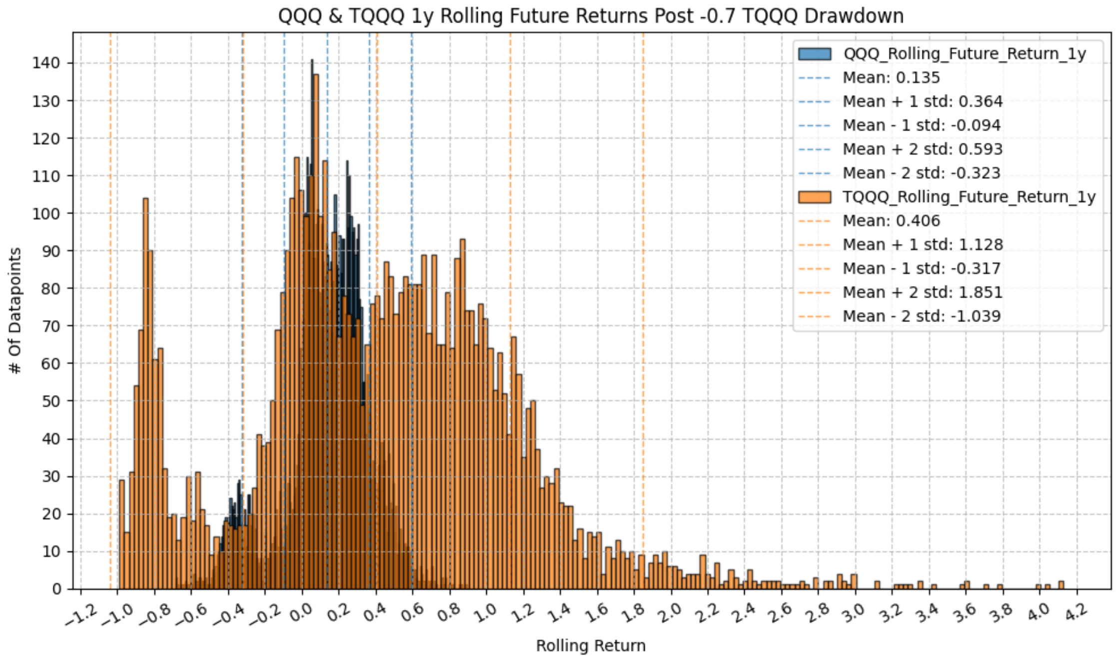
```
0.962
Model:                            OLS   Adj. R-squared:
0.962
Method:                 Least Squares   F-statistic:
1.509e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:30   Log-Likelihood:
7799.9
No. Observations:                5890   AIC:
-1.560e+04
Df Residuals:                    5888   BIC:
-1.558e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0040      0.001     -4.617      0.000
-0.006      -0.002
QQQ_Rolling_Future_Return_3m    2.9067      0.007    388.462      0.000
2.892       2.921
==============================================================================
Omnibus:                     1368.515   Durbin-Watson:                   0.107
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            16450.659
Skew:                           0.766   Prob(JB):                         0.00
Kurtosis:                      11.043   Cond. No.                         8.93
==============================================================================

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

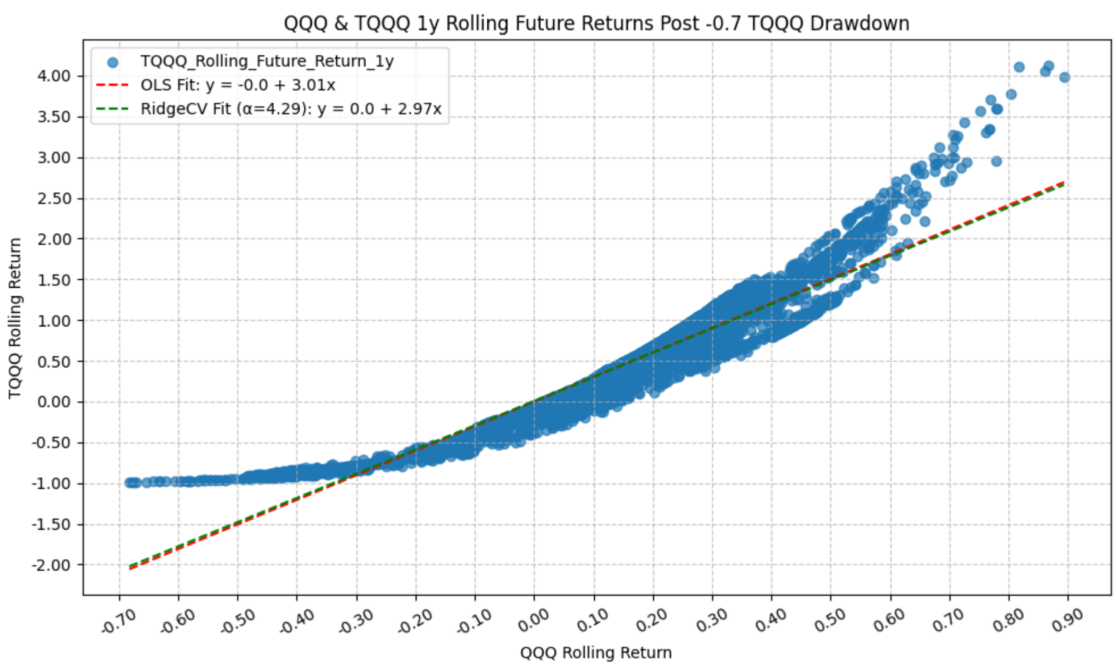





```
                                 OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_6m   R-squared:
```

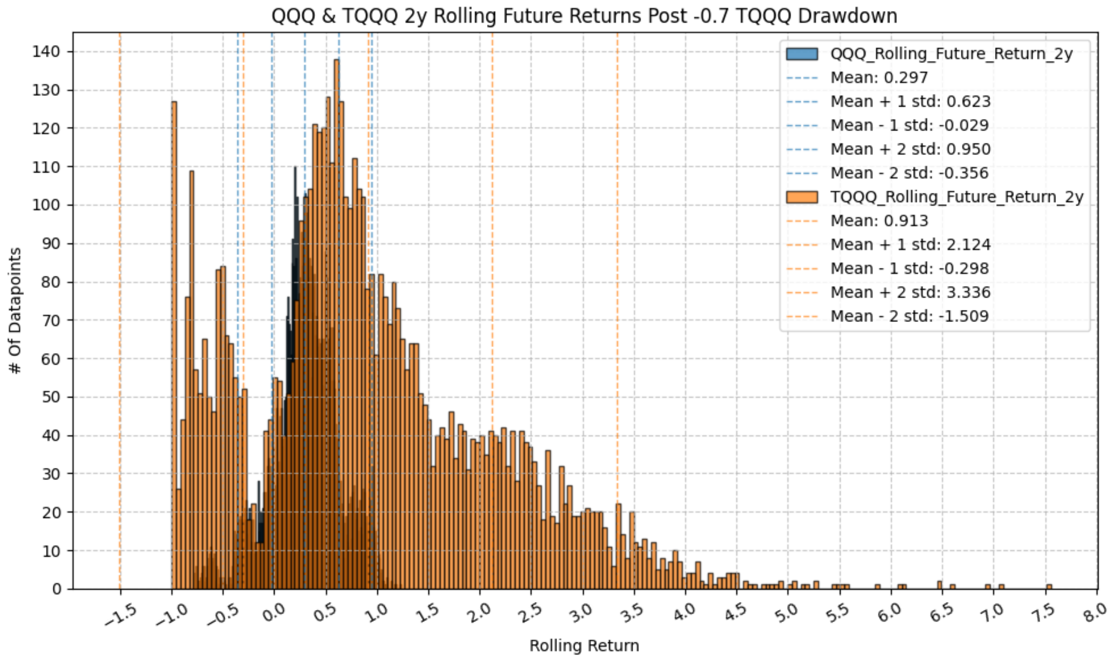
```
0.934
Model:                                   OLS   Adj. R-squared:
0.934
Method:                        Least Squares   F-statistic:
8.379e+04
Date:                       Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                               14:27:31   Log-Likelihood:
4198.9
No. Observations:                       5890   AIC:
-8394.
Df Residuals:                           5888   BIC:
-8380.
Df Model:                                  1
Covariance Type:                   nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0017      0.002     -1.050      0.294
-0.005       0.002
QQQ_Rolling_Future_Return_6m     2.8731      0.010    289.464      0.000
2.854       2.893
==============================================================================
Omnibus:                     1462.300   Durbin-Watson:                   0.063
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8111.743
Skew:                           1.074   Prob(JB):                         0.00
Kurtosis:                       8.333   Cond. No.                         6.45
==============================================================================

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

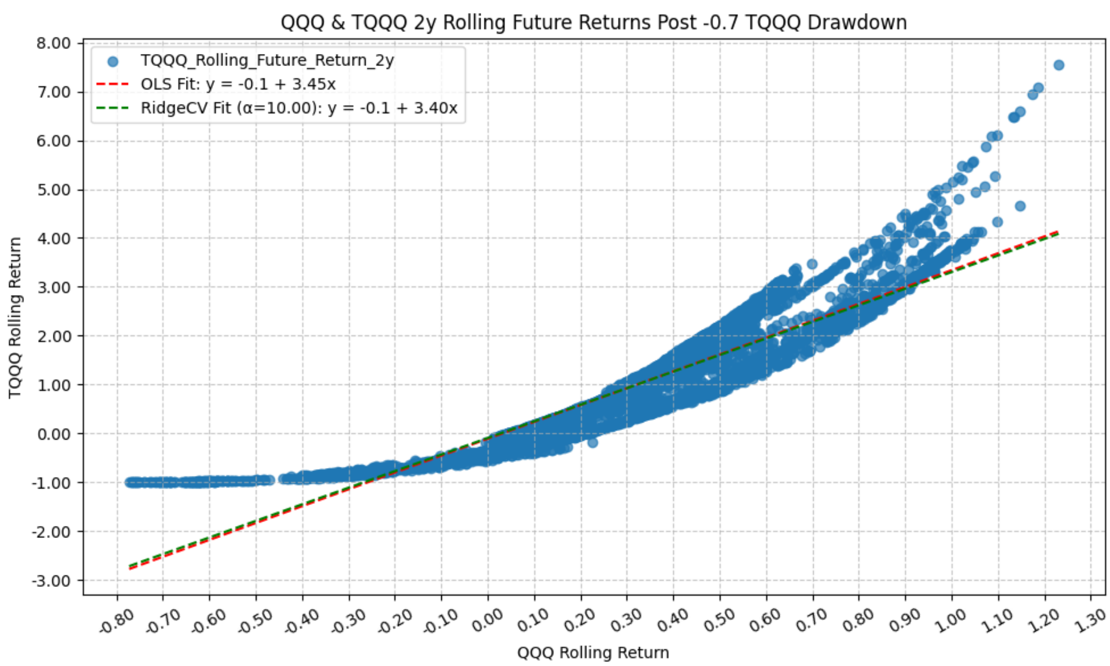





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_1y   R-squared:
```

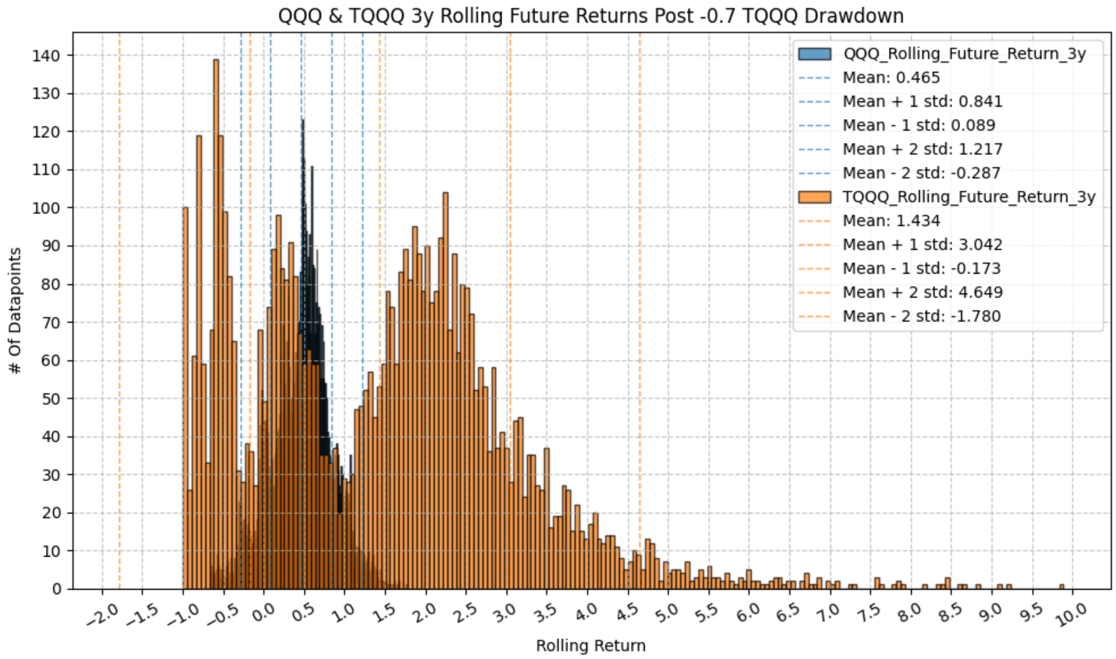
```
0.912
Model:                            OLS   Adj. R-squared:
0.912
Method:                 Least Squares   F-statistic:
6.073e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:32   Log-Likelihood:
715.33
No. Observations:                5852   AIC:
-1427.
Df Residuals:                    5850   BIC:
-1413.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0009      0.003     -0.283      0.777
-0.007       0.005
QQQ_Rolling_Future_Return_1y   3.0133      0.012    246.430      0.000
2.989       3.037
==============================================================================
Omnibus:                     1763.446   Durbin-Watson:                   0.043
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8317.030
Skew:                           1.385   Prob(JB):                         0.00
Kurtosis:                       8.142   Cond. No.                         4.45
==============================================================================

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

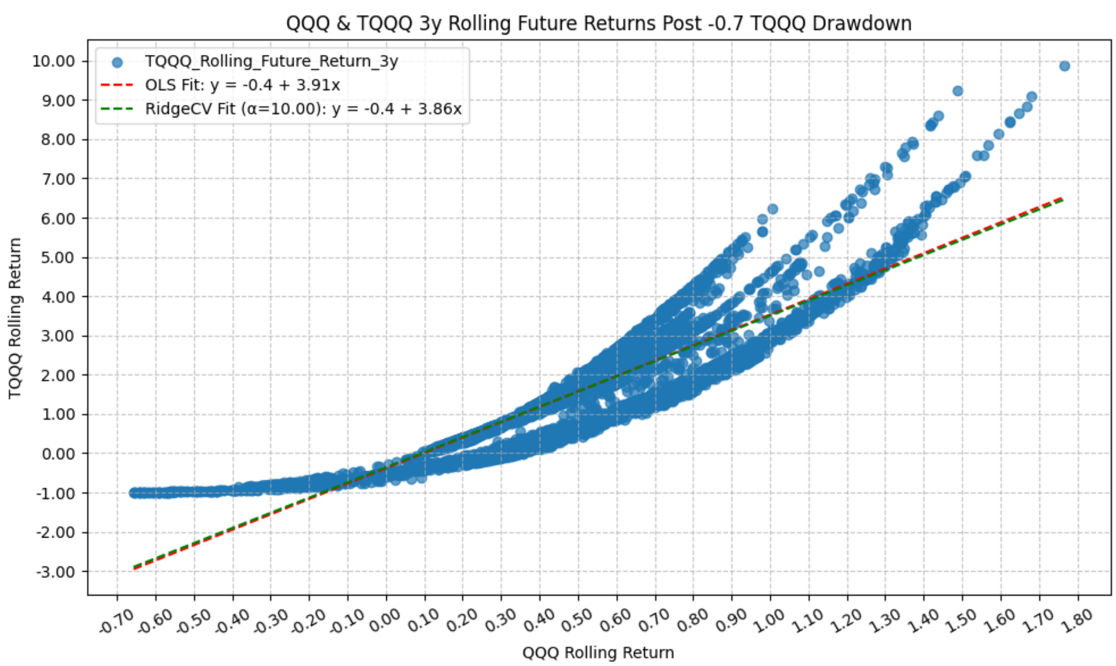





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_2y   R-squared:
```

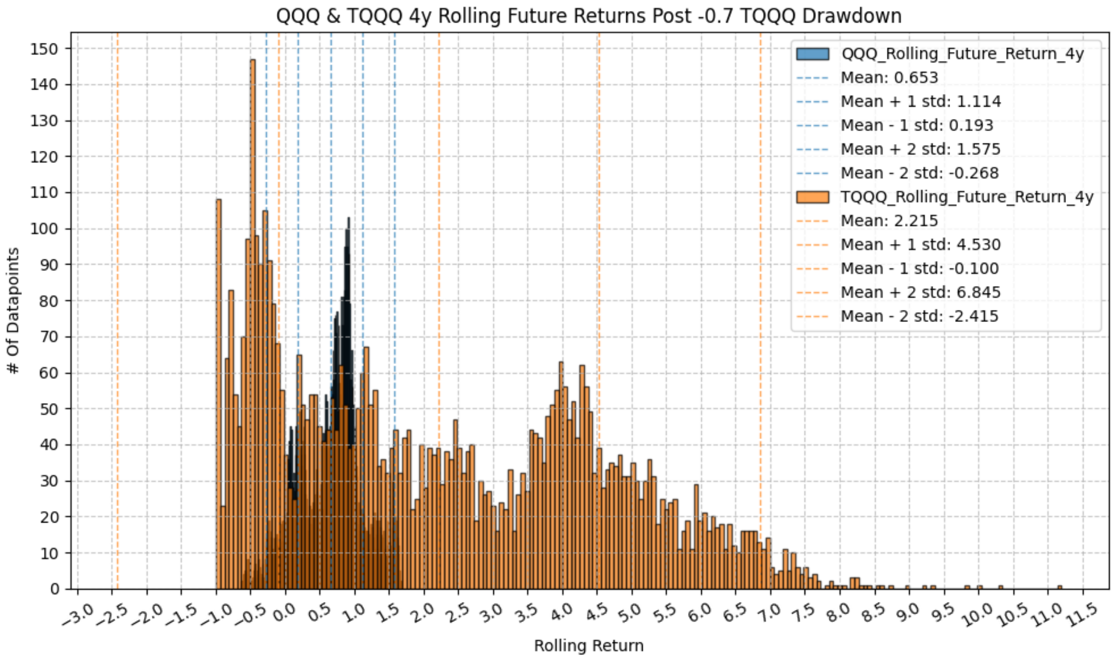
```
0.865
Model:                            OLS   Adj. R-squared:
0.865
Method:                 Least Squares   F-statistic:
3.714e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:33   Log-Likelihood:
-3517.9
No. Observations:                5784   AIC:
7040.
Df Residuals:                    5782   BIC:
7053.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                        -0.1117      0.008    -14.133      0.000
-0.127      -0.096
QQQ_Rolling_Future_Return_2y  3.4522      0.018    192.714      0.000
3.417       3.487
==============================================================================
Omnibus:                     1654.899   Durbin-Watson:                   0.020
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             5619.104
Skew:                           1.427   Prob(JB):                         0.00
Kurtosis:                       6.895   Cond. No.                         3.36
==============================================================================

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

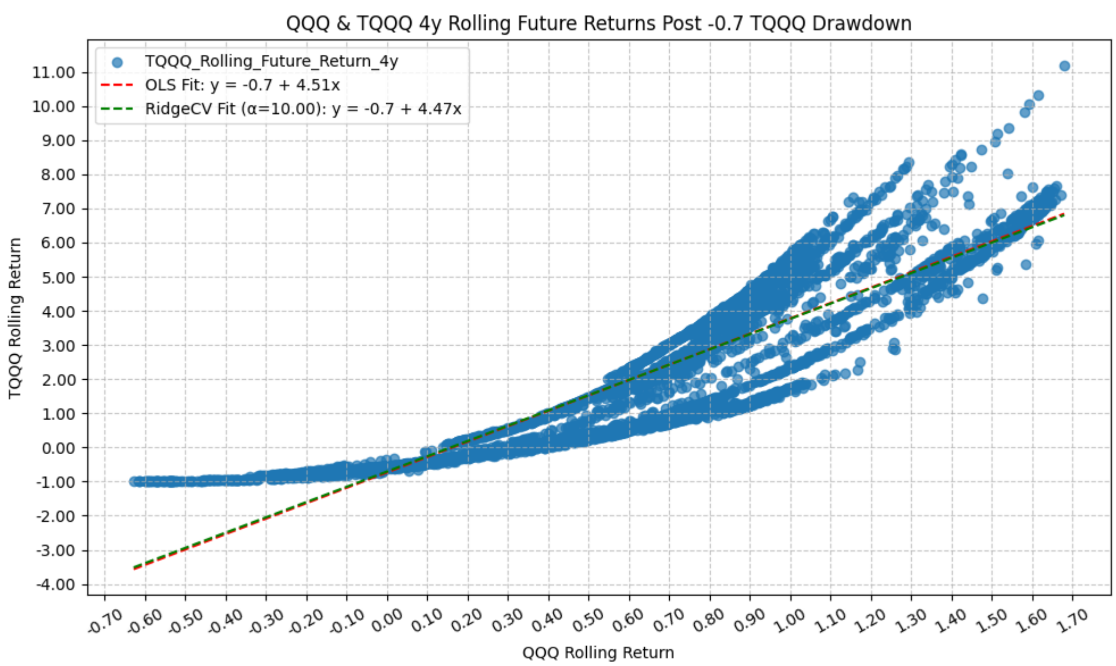





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3y   R-squared:
```

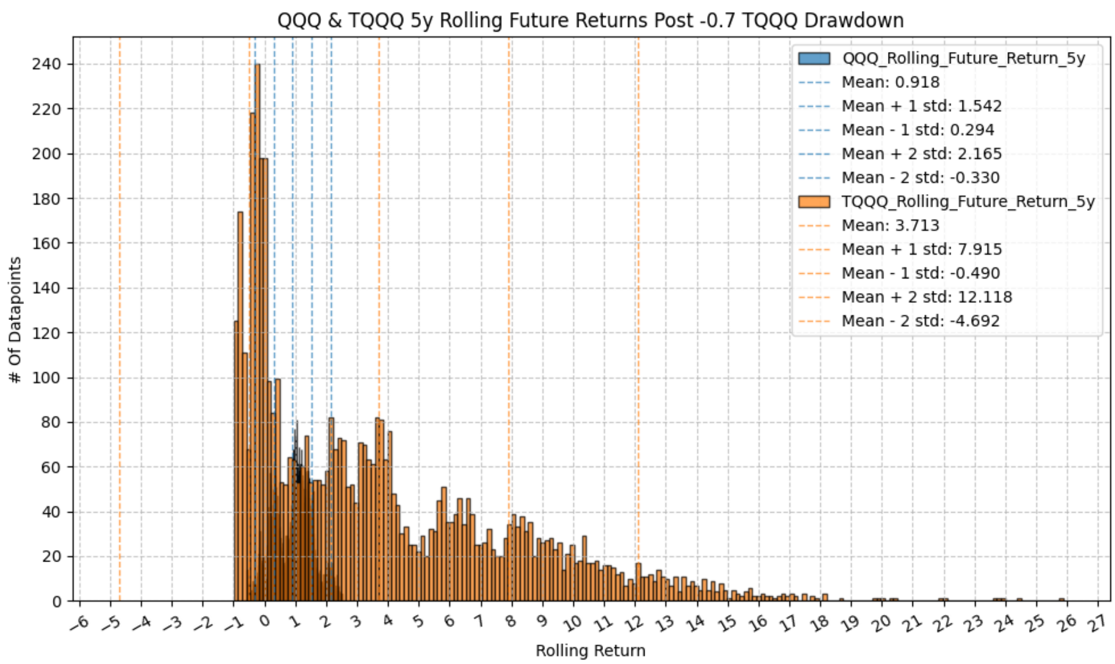
```
0.838
Model:                            OLS   Adj. R-squared:
0.838
Method:                 Least Squares   F-statistic:
2.855e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:34   Log-Likelihood:
-5444.7
No. Observations:                5532   AIC:
1.089e+04
Df Residuals:                    5530   BIC:
1.091e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.3845      0.014    -27.769      0.000
-0.412      -0.357
QQQ_Rolling_Future_Return_3y   3.9132      0.023    168.966      0.000
3.868       3.959
==============================================================================
Omnibus:                      670.448   Durbin-Watson:                   0.016
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1243.454
Skew:                           0.791   Prob(JB):                    9.71e-271
Kurtosis:                       4.700   Cond. No.                         3.31
==============================================================================

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

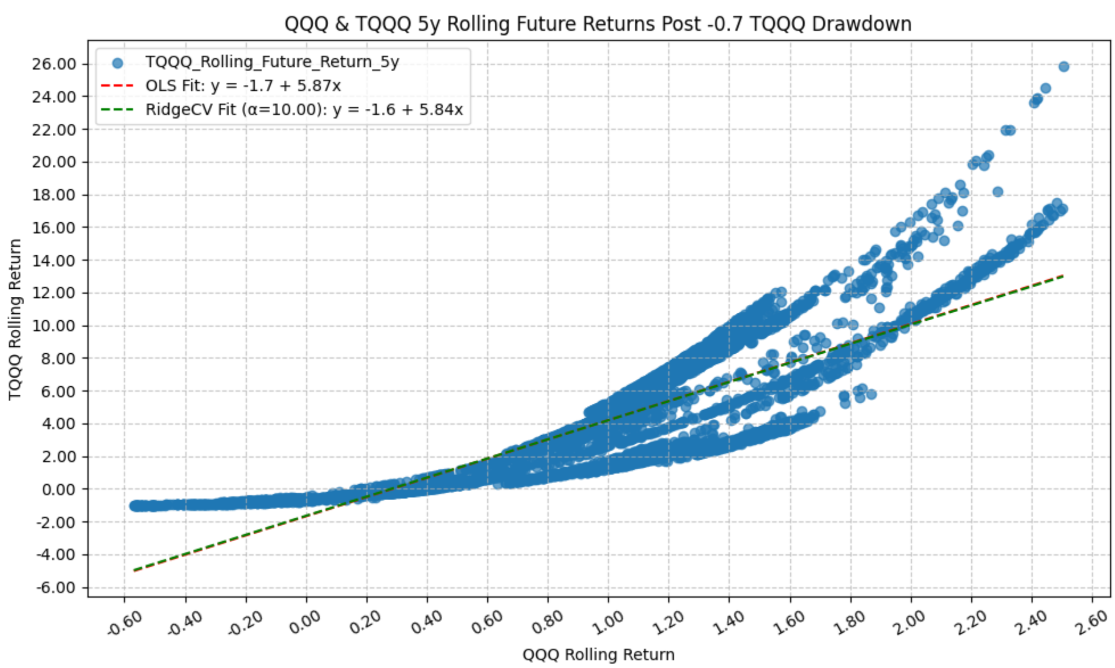





```
                                 OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_4y   R-squared:
```

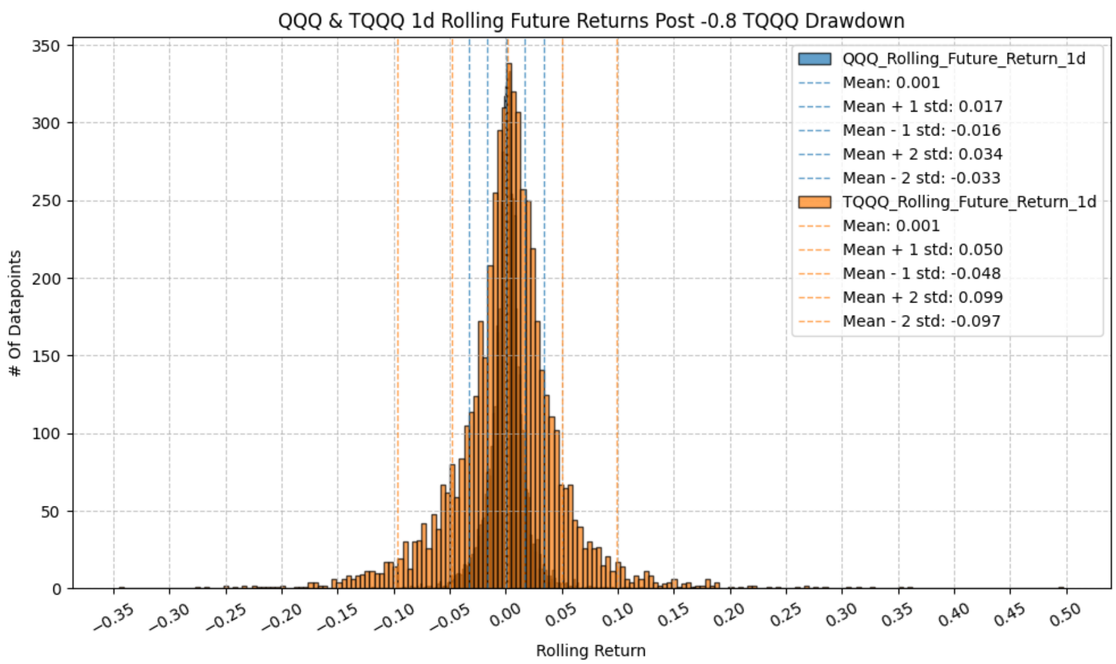
```
0.806
Model:                                   OLS   Adj. R-squared:
0.806
Method:                        Least Squares   F-statistic:
2.190e+04
Date:                       Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                               14:27:36   Log-Likelihood:
-7596.8
No. Observations:                       5280   AIC:
1.520e+04
Df Residuals:                           5278   BIC:
1.521e+04
Df Model:                                  1
Covariance Type:                   nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.7323      0.024    -30.052      0.000
-0.780      -0.685
QQQ_Rolling_Future_Return_4y    4.5109      0.030    147.996      0.000
4.451       4.571
==============================================================================
Omnibus:                       12.319   Durbin-Watson:                   0.011
Prob(Omnibus):                  0.002   Jarque-Bera (JB):               10.050
Skew:                          -0.007   Prob(JB):                      0.00657
Kurtosis:                       2.787   Cond. No.                         3.25
==============================================================================

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

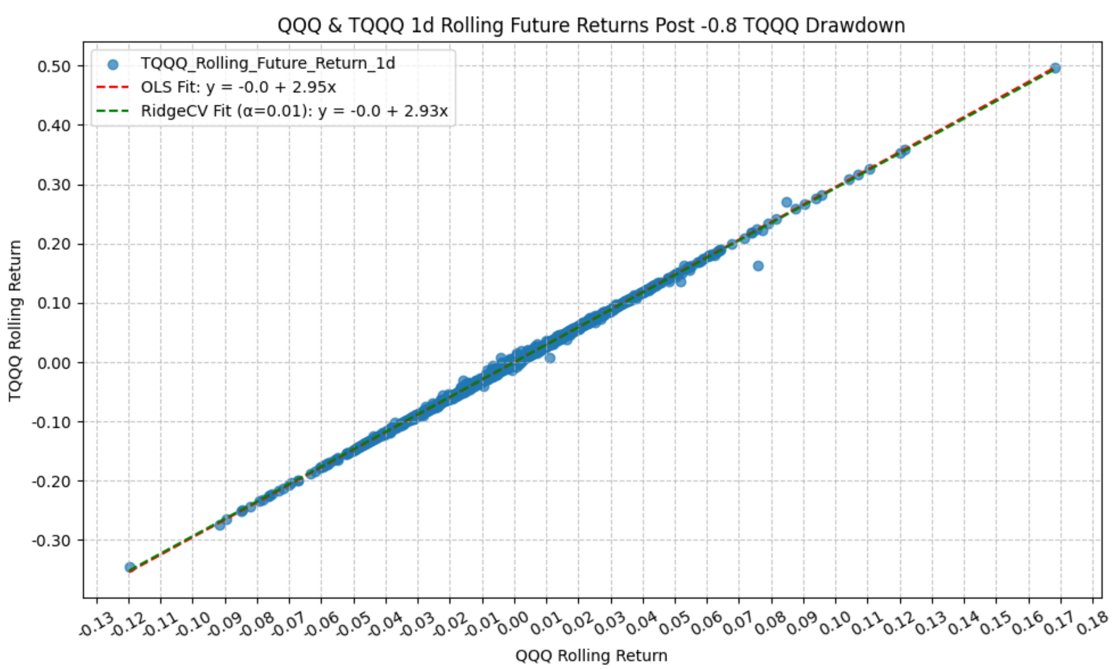





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_5y   R-squared:
```

```
0.759
Model:                            OLS   Adj. R-squared:
0.759
Method:                 Least Squares   F-statistic:
1.625e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:37   Log-Likelihood:
-11052.
No. Observations:                5158   AIC:
2.211e+04
Df Residuals:                    5156   BIC:
2.212e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -1.6745      0.051    -32.771      0.000
-1.775      -1.574
QQQ_Rolling_Future_Return_5y   5.8696      0.046    127.481      0.000
5.779       5.960
==============================================================================
Omnibus:                      168.503   Durbin-Watson:                   0.010
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              287.431
Skew:                           0.281   Prob(JB):                     3.85e-63
Kurtosis:                       4.010   Cond. No.                         3.27
==============================================================================

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

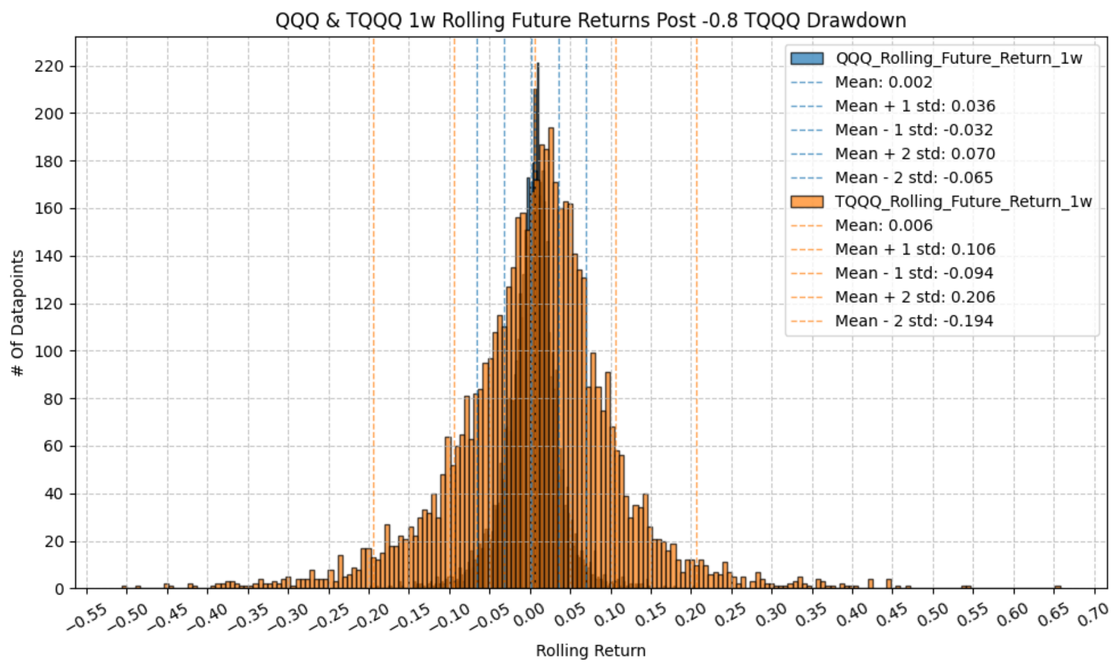


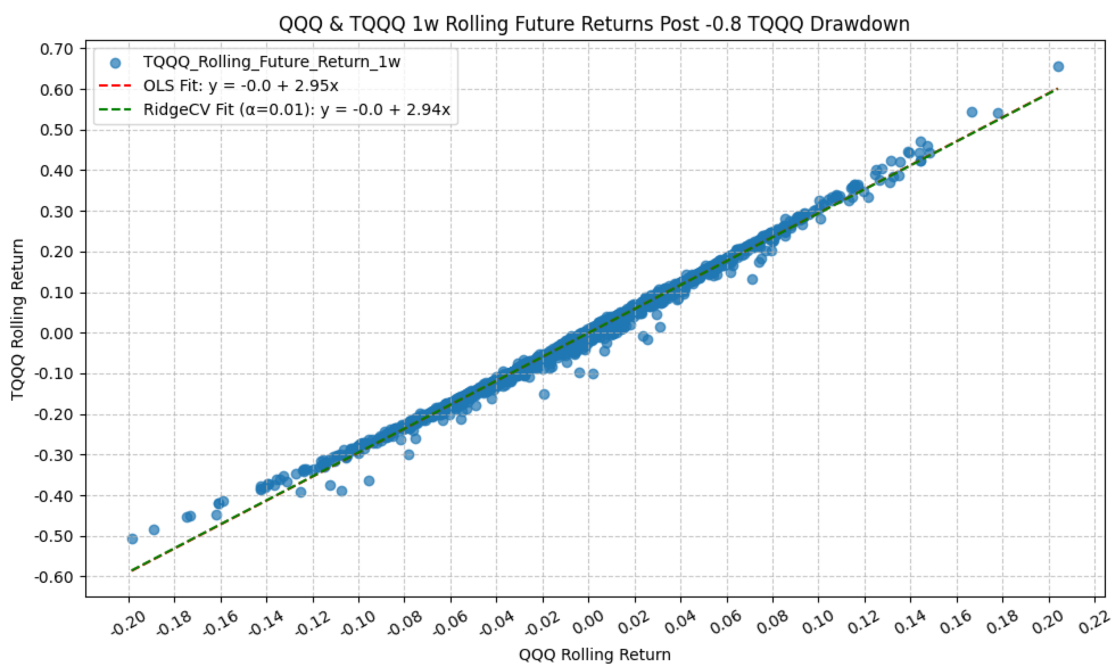


OLS Regression Results

```
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1d   R-squared:
```

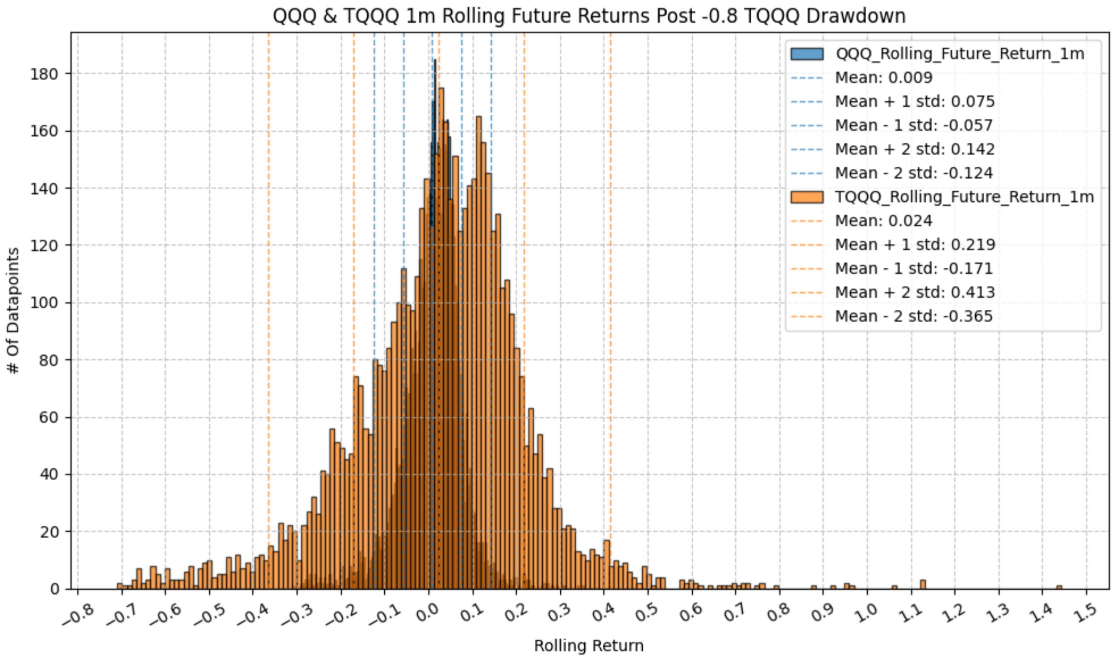
```
0.999
Model:                                    OLS   Adj. R-squared:
0.999
Method:                         Least Squares   F-statistic:
4.764e+06
Date:                        Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                14:27:38   Log-Likelihood:
27156.
No. Observations:                        5448   AIC:
-5.431e+04
Df Residuals:                            5446   BIC:
-5.429e+04
Df Model:                                   1
Covariance Type:                    nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                       -1.568e-05   2.24e-05     -0.699      0.485
-5.97e-05    2.83e-05
QQQ_Rolling_Future_Return_1d     2.9531      0.001   2182.718      0.000
2.950       2.956
==============================================================================
Omnibus:                     8179.872   Durbin-Watson:                   2.578
Prob(Omnibus):                  0.000   Jarque-Bera (JB):         30309716.309
Skew:                          -8.324   Prob(JB):                         0.00
Kurtosis:                     368.029   Cond. No.                         60.3
==============================================================================

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

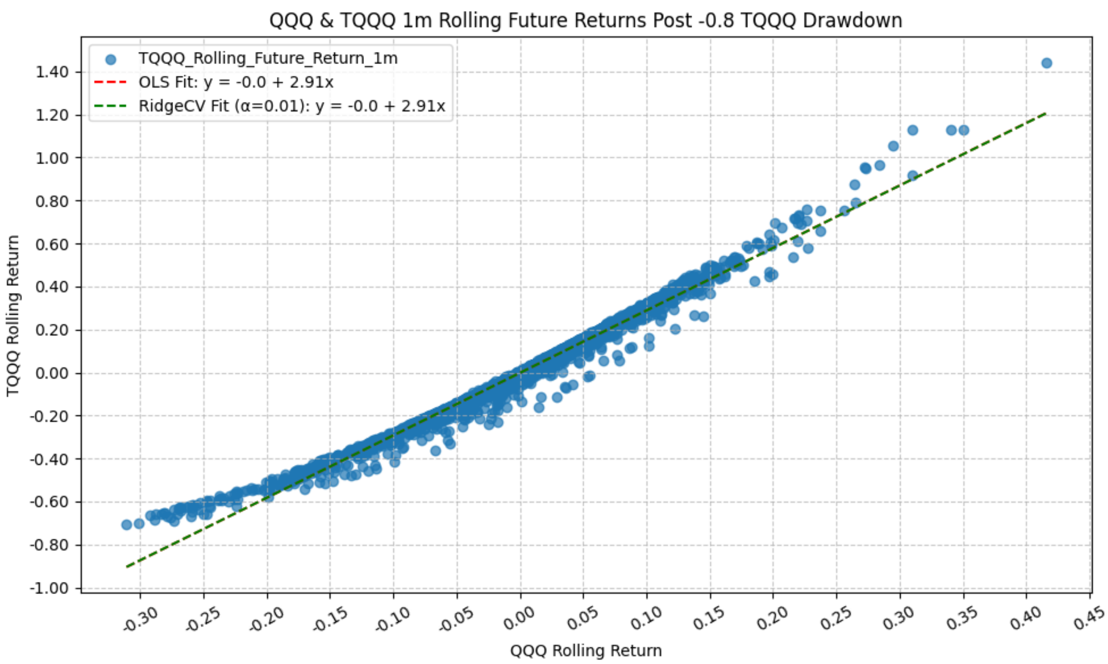





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1w   R-squared:
```

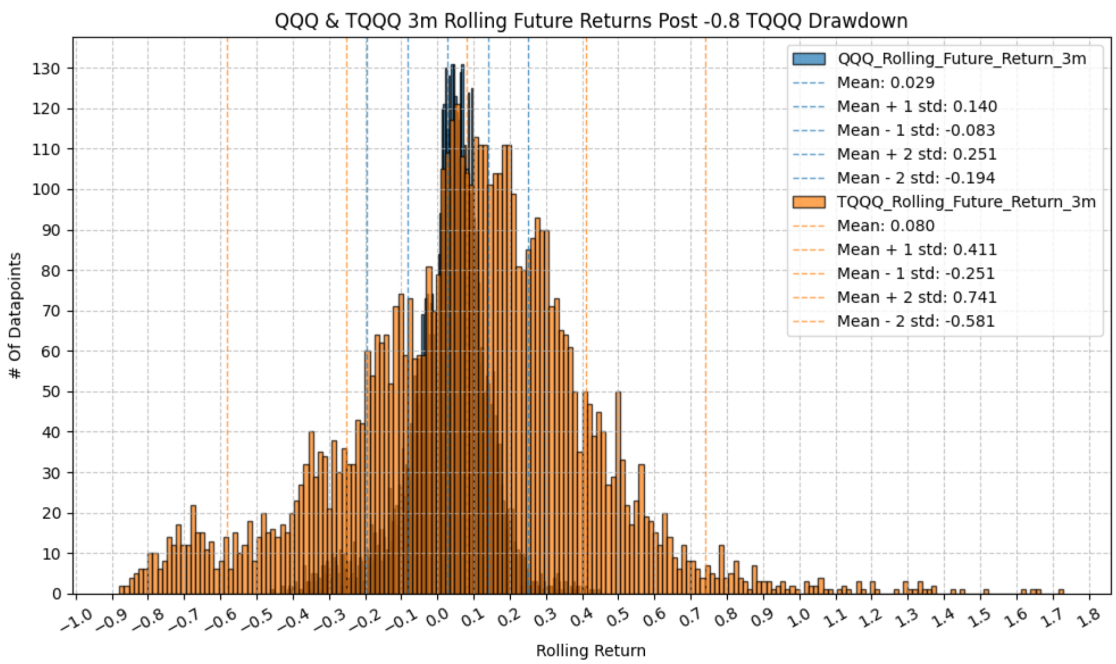
```
0.994
Model:                            OLS   Adj. R-squared:
0.994
Method:                 Least Squares   F-statistic:
9.352e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:39   Log-Likelihood:
18848.
No. Observations:                5448   AIC:
-3.769e+04
Df Residuals:                    5446   BIC:
-3.768e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0006      0.000     -5.487      0.000
-0.001      -0.000
QQQ_Rolling_Future_Return_1w   2.9495      0.003    967.032      0.000
2.943       2.955
==============================================================================
Omnibus:                     3225.193   Durbin-Watson:                   0.872
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           383535.806
Skew:                          -1.881   Prob(JB):                         0.00
Kurtosis:                      43.932   Cond. No.                         29.6
==============================================================================

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

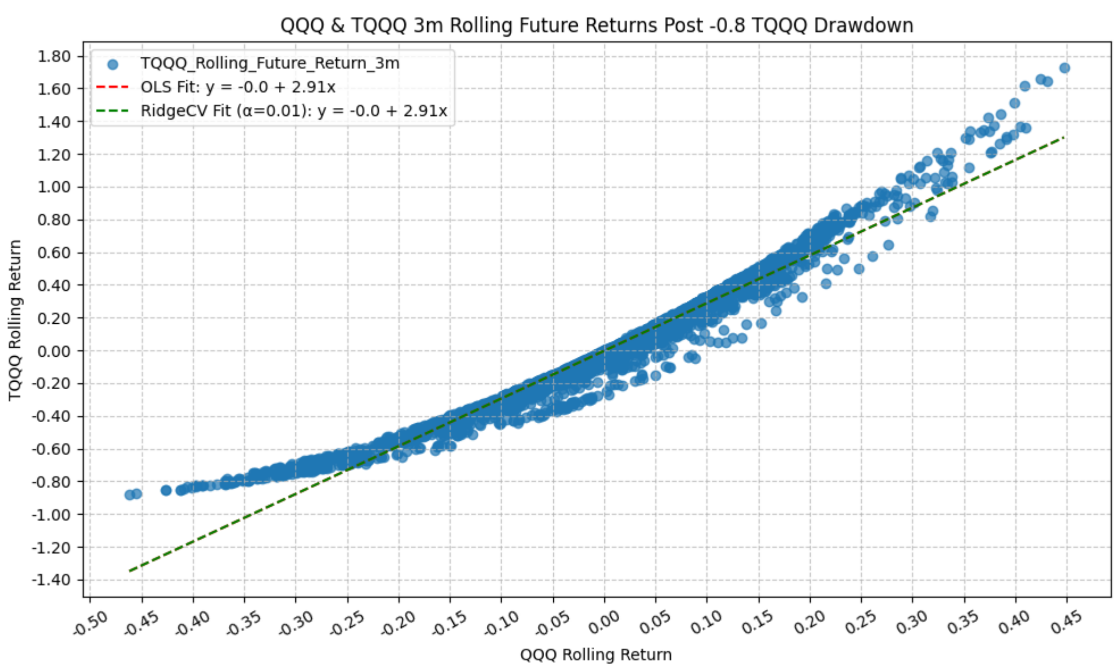





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_1m   R-squared:
```

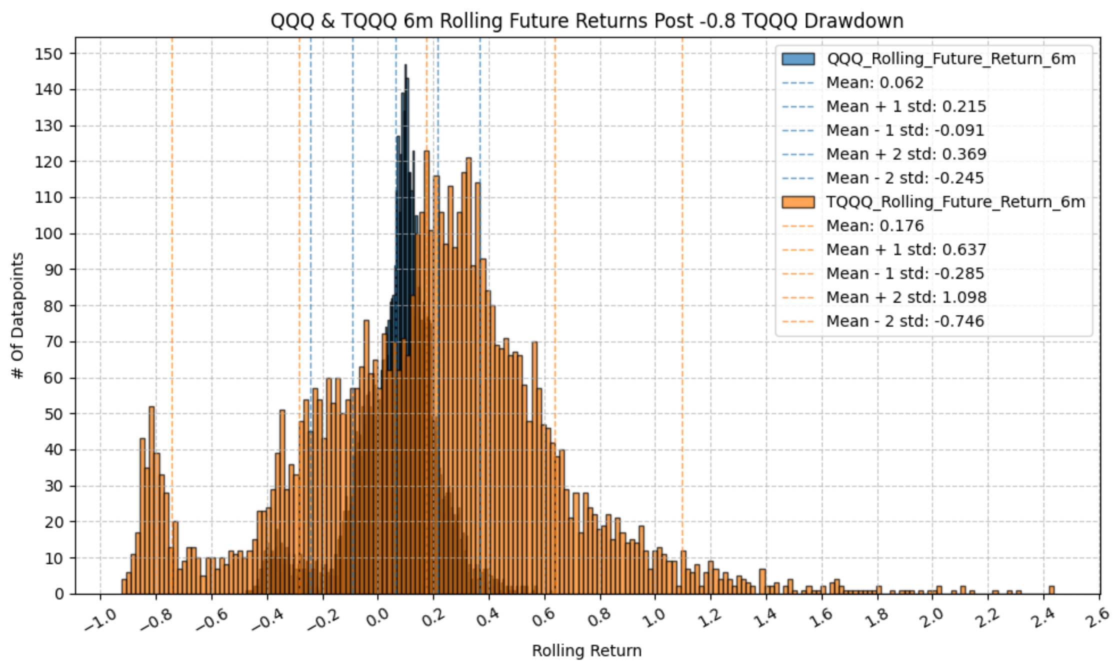
```
0.982
Model:                            OLS   Adj. R-squared:
0.982
Method:                 Least Squares   F-statistic:
3.034e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:40   Log-Likelihood:
12185.
No. Observations:                5448   AIC:
-2.437e+04
Df Residuals:                    5446   BIC:
-2.435e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0021      0.000     -5.896      0.000
-0.003      -0.001
QQQ_Rolling_Future_Return_1m    2.9063      0.005    550.837      0.000
2.896       2.917
==============================================================================
Omnibus:                     1330.394   Durbin-Watson:                   0.299
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            76723.084
Skew:                           0.205   Prob(JB):                         0.00
Kurtosis:                      21.380   Cond. No.                         15.1
==============================================================================

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

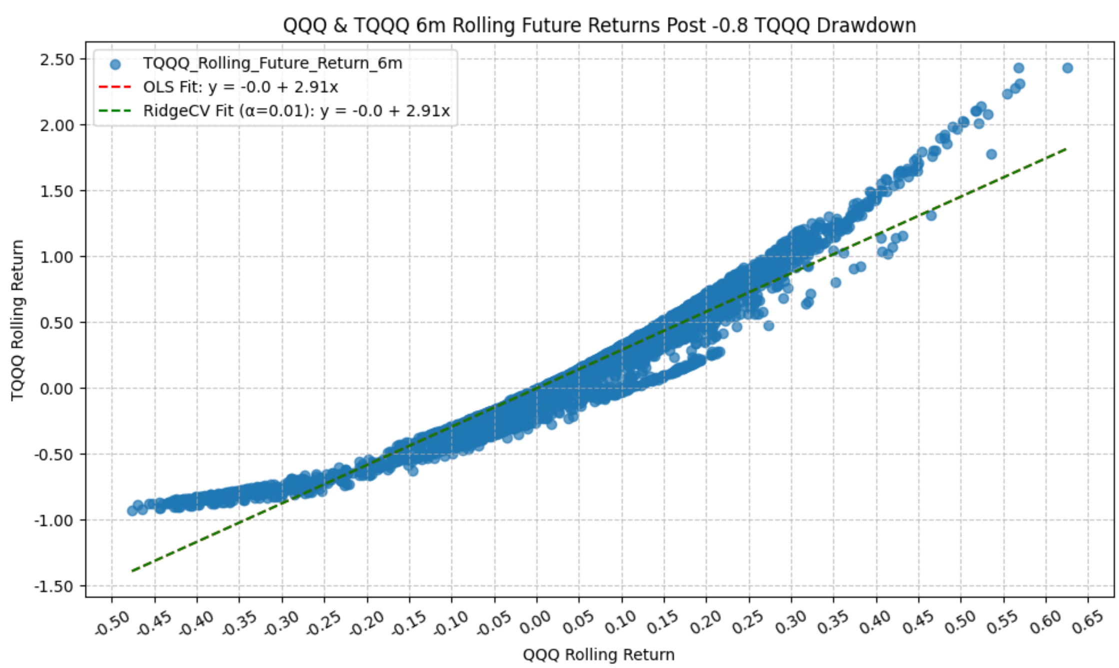





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_3m   R-squared:
```

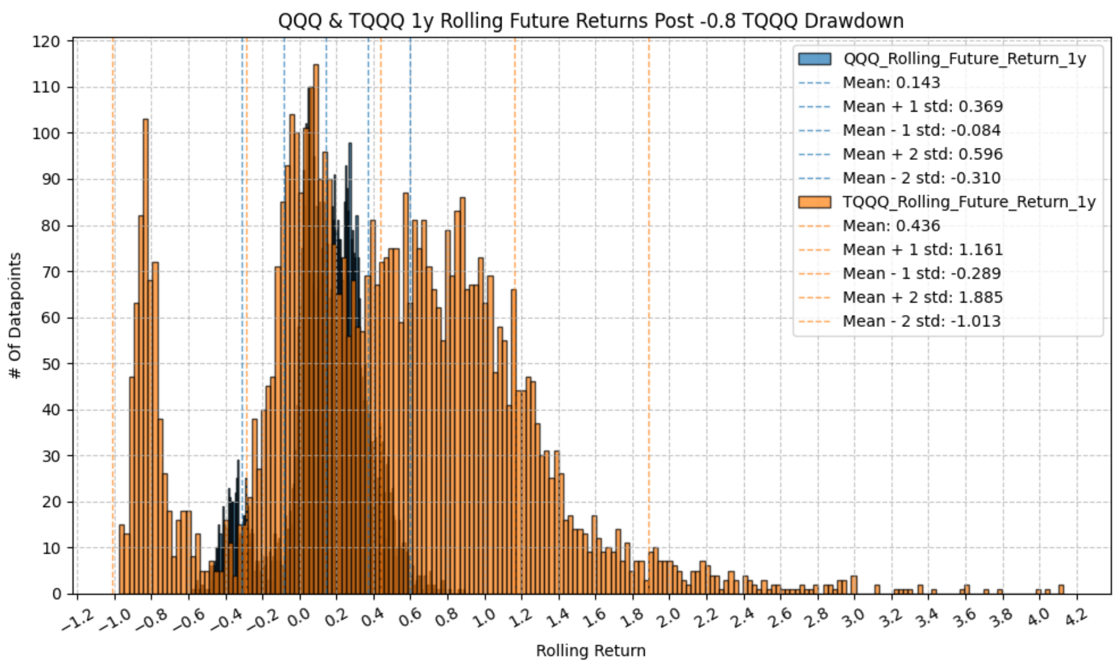
```
0.961
Model:                                OLS   Adj. R-squared:
0.961
Method:                     Least Squares   F-statistic:
1.351e+05
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:27:41   Log-Likelihood:
7156.4
No. Observations:                    5448   AIC:
-1.431e+04
Df Residuals:                        5446   BIC:
-1.430e+04
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0035      0.001     -3.894      0.000
-0.005      -0.002
QQQ_Rolling_Future_Return_3m    2.9141      0.008    367.616      0.000
2.899       2.930
==============================================================================
Omnibus:                     1264.052   Durbin-Watson:                   0.097
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            15799.603
Skew:                           0.751   Prob(JB):                         0.00
Kurtosis:                      11.206   Cond. No.                         9.00
==============================================================================

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

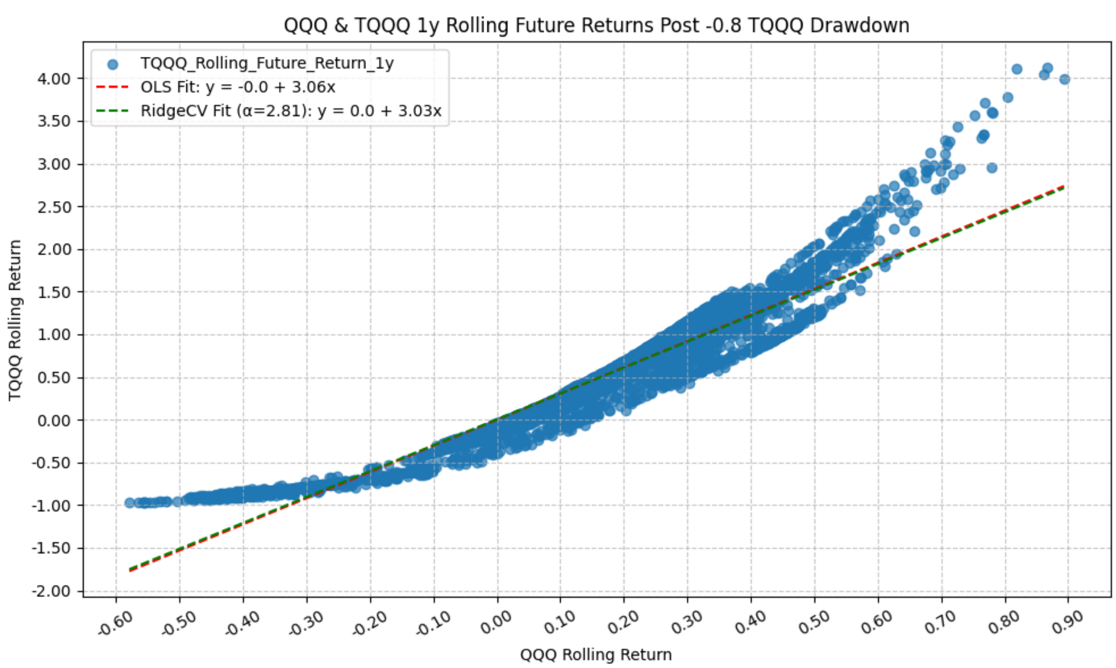





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_6m   R-squared:
```

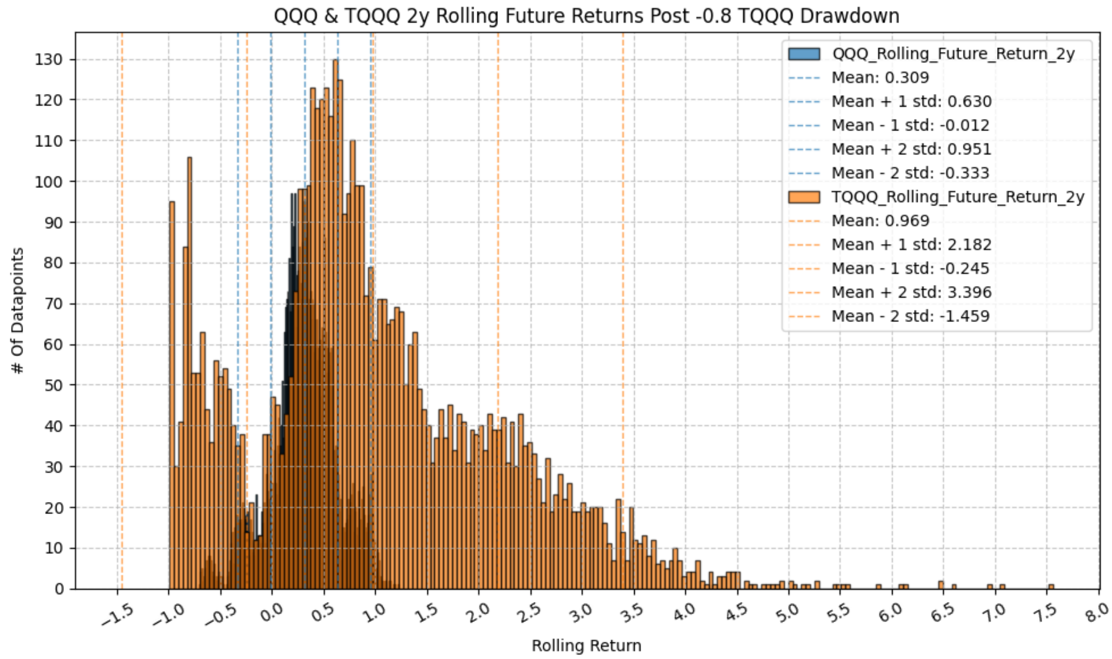
```
0.937
Model:                            OLS   Adj. R-squared:
0.937
Method:                 Least Squares   F-statistic:
8.113e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:43   Log-Likelihood:
4025.3
No. Observations:                5448   AIC:
-8047.
Df Residuals:                    5446   BIC:
-8033.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0043      0.002     -2.530      0.011
-0.008      -0.001
QQQ_Rolling_Future_Return_6m   2.9102      0.010    284.832      0.000
2.890       2.930
==============================================================================
Omnibus:                      970.459   Durbin-Watson:                   0.062
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4545.928
Skew:                           0.789   Prob(JB):                         0.00
Kurtosis:                       7.188   Cond. No.                         6.55
==============================================================================

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

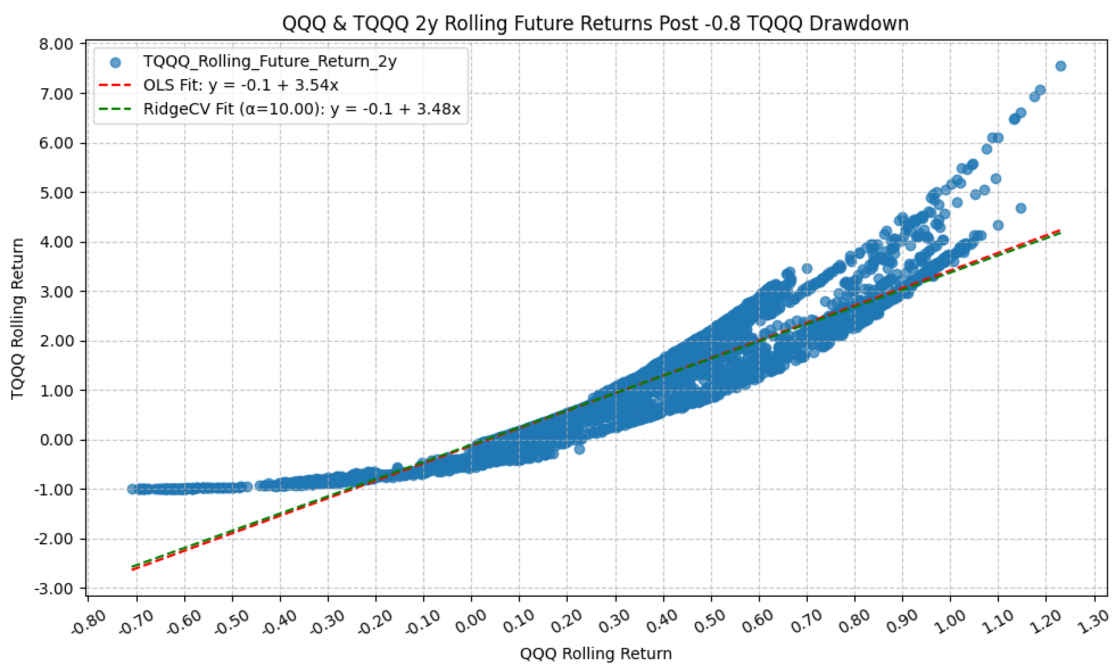





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_1y   R-squared:
```

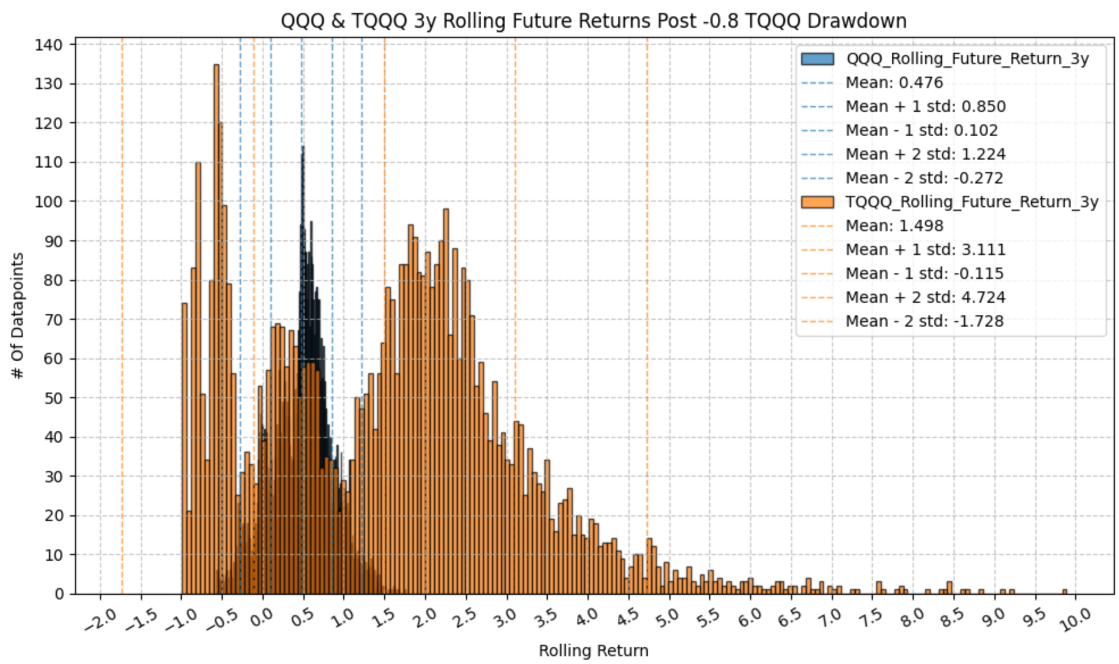
```
0.917
Model:                                   OLS   Adj. R-squared:
0.917
Method:                        Least Squares   F-statistic:
5.978e+04
Date:                       Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                               14:27:44   Log-Likelihood:
790.32
No. Observations:                       5444   AIC:
-1577.
Df Residuals:                           5442   BIC:
-1563.
Df Model:                                  1
Covariance Type:                   nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.0018      0.003     -0.540      0.589
-0.008       0.005
QQQ_Rolling_Future_Return_1y     3.0627      0.013    244.506      0.000
3.038       3.087
==============================================================================
Omnibus:                     1400.332   Durbin-Watson:                   0.045
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             6204.356
Skew:                           1.186   Prob(JB):                         0.00
Kurtosis:                       7.661   Cond. No.                         4.51
==============================================================================

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

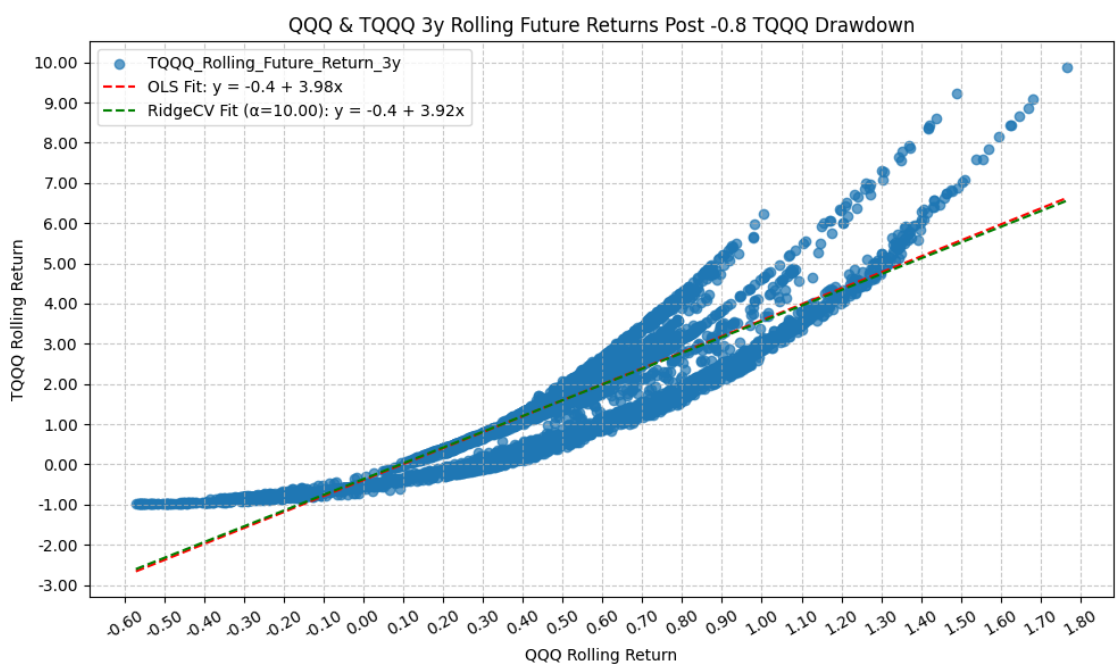





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_2y   R-squared:
```

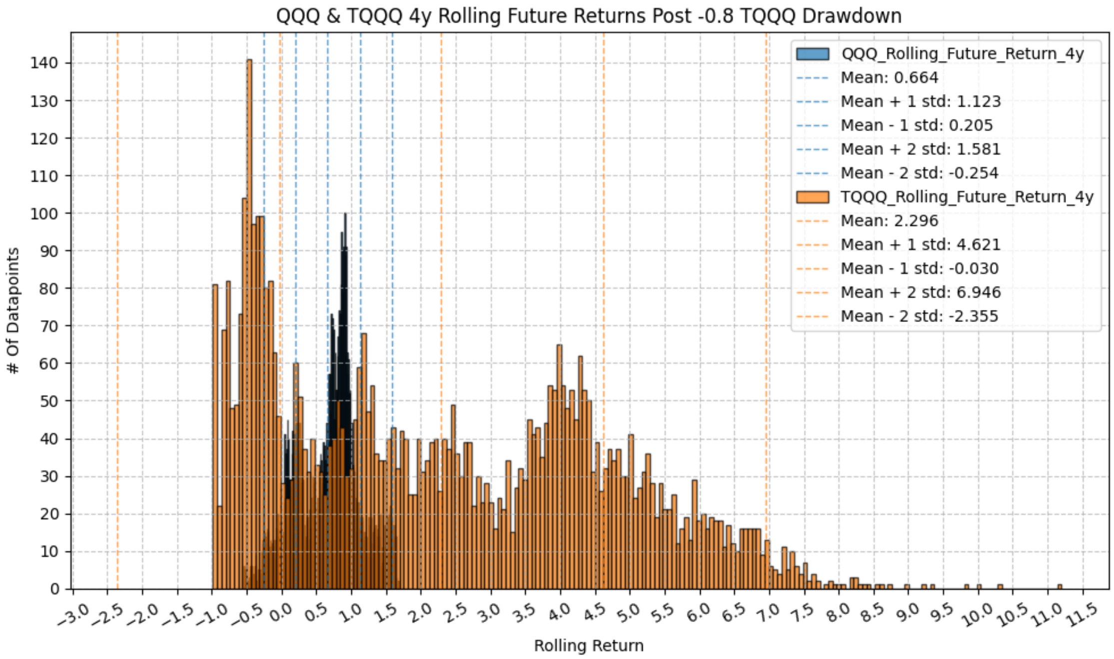
```
0.876
Model:                                OLS   Adj. R-squared:
0.876
Method:                     Least Squares   F-statistic:
3.833e+04
Date:                    Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                            14:27:45   Log-Likelihood:
-3103.9
No. Observations:                    5444   AIC:
6212.
Df Residuals:                        5442   BIC:
6225.
Df Model:                               1
Covariance Type:                nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.1256      0.008    -15.596      0.000
-0.141      -0.110
QQQ_Rolling_Future_Return_2y   3.5395      0.018    195.774      0.000
3.504       3.575
==============================================================================
Omnibus:                     1478.767   Durbin-Watson:                   0.022
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             5089.206
Skew:                           1.346   Prob(JB):                         0.00
Kurtosis:                       6.898   Cond. No.                         3.45
==============================================================================

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

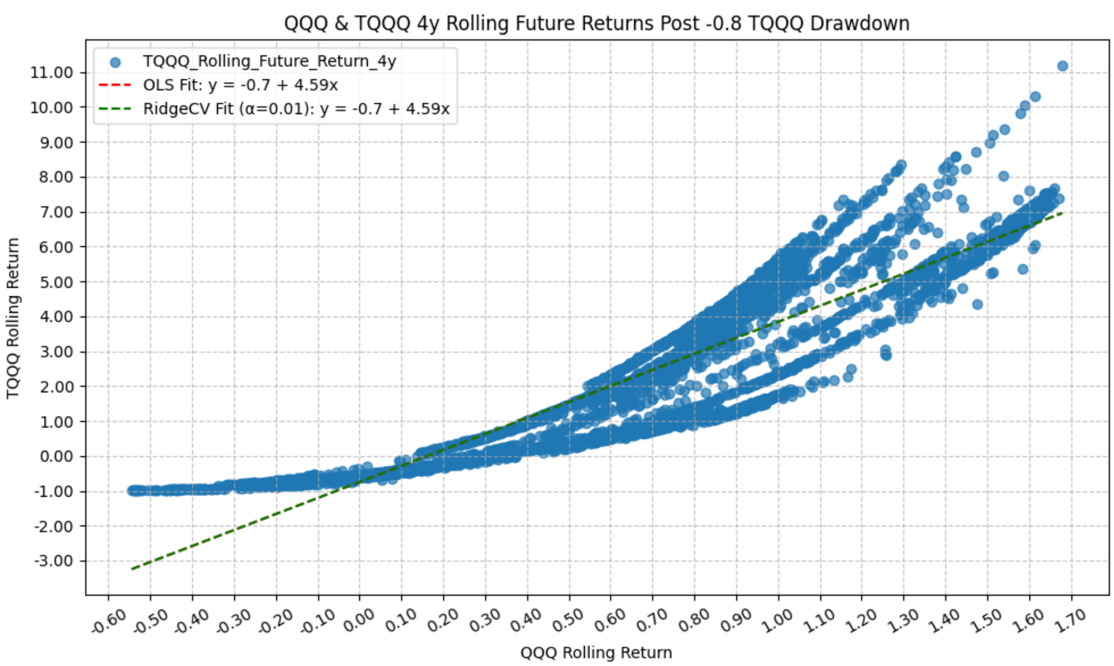





```
                           OLS Regression Results
==============================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_3y   R-squared:
```

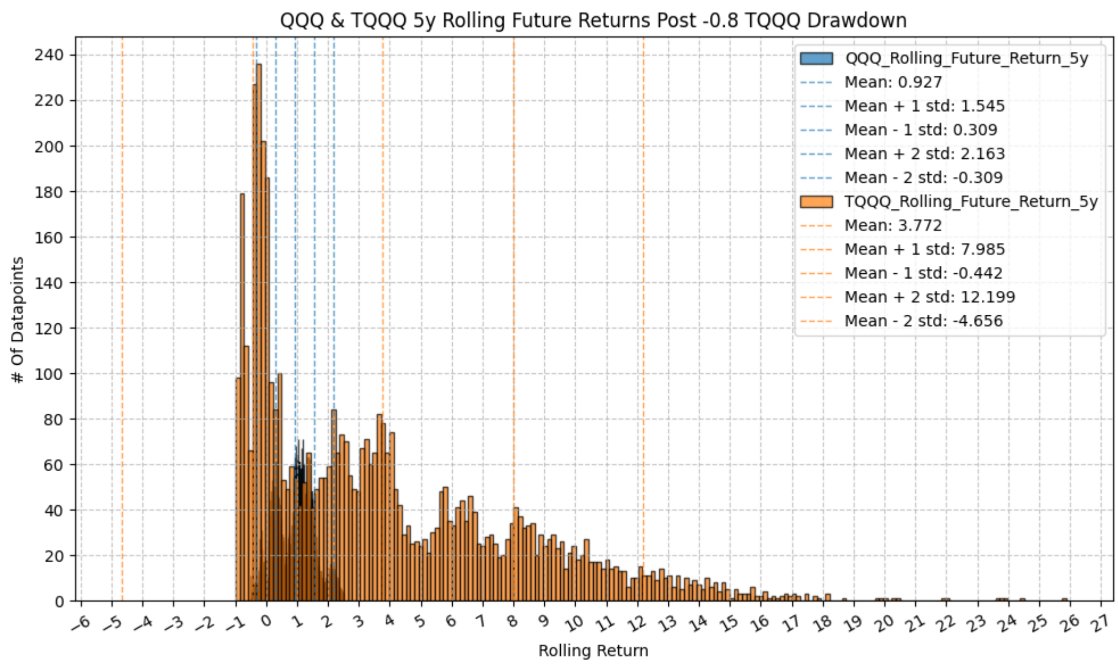
```
0.850
Model:                            OLS   Adj. R-squared:
0.850
Method:                 Least Squares   F-statistic:
2.988e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:46   Log-Likelihood:
-5021.0
No. Observations:                5289   AIC:
1.005e+04
Df Residuals:                    5287   BIC:
1.006e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.3933      0.014    -28.260      0.000
-0.421      -0.366
QQQ_Rolling_Future_Return_3y    3.9757      0.023    172.869      0.000
3.931       4.021
==============================================================================
Omnibus:                      578.227   Durbin-Watson:                   0.018
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1146.794
Skew:                           0.704   Prob(JB):                    9.48e-250
Kurtosis:                       4.795   Cond. No.                         3.36
==============================================================================

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

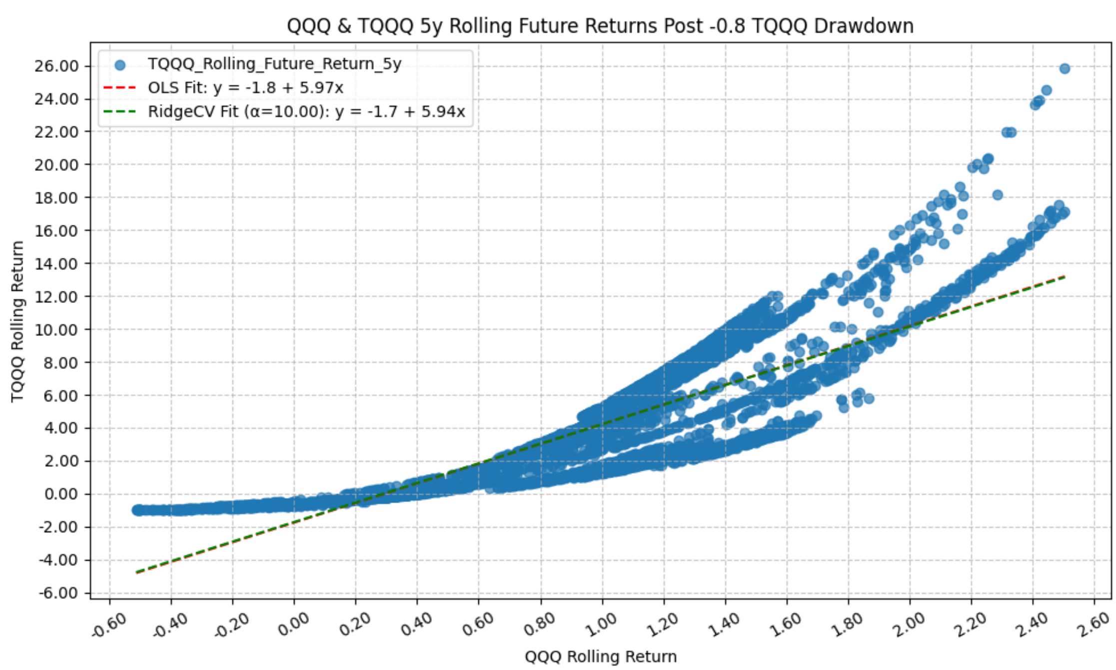





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:      TQQQ_Rolling_Future_Return_4y   R-squared:
```

```
0.820
Model:                            OLS   Adj. R-squared:
0.820
Method:                 Least Squares   F-statistic:
2.303e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:47   Log-Likelihood:
-7126.5
No. Observations:                5068   AIC:
1.426e+04
Df Residuals:                    5066   BIC:
1.427e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         -0.7486      0.024    -30.693      0.000
-0.796      -0.701
QQQ_Rolling_Future_Return_4y   4.5873      0.030    151.752      0.000
4.528       4.647
==============================================================================
Omnibus:                       13.154   Durbin-Watson:                   0.011
Prob(Omnibus):                  0.001   Jarque-Bera (JB):               13.239
Skew:                          -0.121   Prob(JB):                      0.00133
Kurtosis:                       2.934   Cond. No.                         3.29
==============================================================================

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






```
                              OLS Regression Results
================================================================================
=========
Dep. Variable:     TQQQ_Rolling_Future_Return_5y   R-squared:
```

```
0.766
Model:                                  OLS   Adj. R-squared:
0.766
Method:                       Least Squares   F-statistic:
1.659e+04
Date:                      Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                              14:27:48   Log-Likelihood:
-10800.
No. Observations:                      5068   AIC:
2.160e+04
Df Residuals:                          5066   BIC:
2.162e+04
Df Model:                                 1
Covariance Type:                  nonrobust
================================================================================
================
                              coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                      -1.7612      0.052    -34.112      0.000
-1.862      -1.660
QQQ_Rolling_Future_Return_5y     5.9669      0.046    128.790      0.000
5.876       6.058
==============================================================================
Omnibus:                      145.200   Durbin-Watson:                   0.010
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              276.778
Skew:                           0.210   Prob(JB):                     7.91e-61
Kurtosis:                       4.065   Cond. No.                         3.33
==============================================================================

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

0.4.9 Rolling Returns Following Drawdowns Deviation (QQQ & TQQQ)

[37]:

```
rolling_returns_positive_future_returns = pd.DataFrame(index=rolling_windows.
↪keys(), data=rolling_windows.values())
rolling_returns_positive_future_returns.reset_index(inplace=True)
rolling_returns_positive_future_returns.rename(columns={"index":"Period", 0:
↪"Days"}, inplace=True)

for drawdown in drawdown_levels:
    temp = rolling_returns_drawdown_stats.
↪loc[rolling_returns_drawdown_stats["Drawdown"] == drawdown]
```

```
    temp = temp[["Period", "Positive_Future_Percentage"]]
    temp.rename(columns={"Positive_Future_Percentage" :␣
↪f"Positive_Future_Percentage_Post_{drawdown}_Drawdown"}, inplace=True)
    rolling_returns_positive_future_returns = pd.
↪merge(rolling_returns_positive_future_returns, temp, left_on="Period",␣
↪right_on="Period", how="outer")
    rolling_returns_positive_future_returns.sort_values(by="Days",␣
↪ascending=True, inplace=True)

rolling_returns_positive_future_returns.drop(columns={"Days"}, inplace=True)
rolling_returns_positive_future_returns.reset_index(drop=True, inplace=True)
display(rolling_returns_positive_future_returns)
```

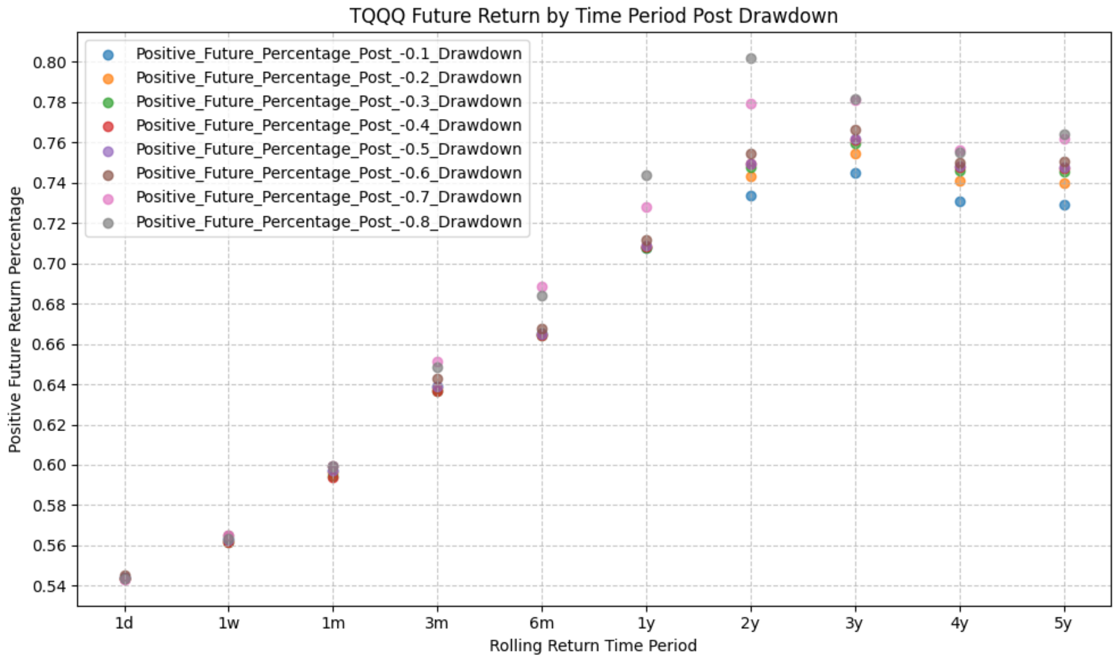
```
  Period  Positive_Future_Percentage_Post_-0.1_Drawdown  \
0     1d                                          0.544
1     1w                                          0.563
2     1m                                          0.597
3     3m                                          0.639
4     6m                                          0.665
5     1y                                          0.708
6     2y                                          0.734
7     3y                                          0.745
8     4y                                          0.731
9     5y                                          0.729

   Positive_Future_Percentage_Post_-0.2_Drawdown  \
0                                          0.543
1                                          0.562
2                                          0.596
3                                          0.638
4                                          0.665
5                                          0.708
6                                          0.743
7                                          0.755
8                                          0.741
9                                          0.740

   Positive_Future_Percentage_Post_-0.3_Drawdown  \
0                                          0.544
1                                          0.562
2                                          0.594
3                                          0.637
4                                          0.664
5                                          0.708
6                                          0.748
7                                          0.760
8                                          0.746
```

```
9                                          0.746

   Positive_Future_Percentage_Post_-0.4_Drawdown  \
0                                          0.543
1                                          0.562
2                                          0.594
3                                          0.637
4                                          0.664
5                                          0.708
6                                          0.749
7                                          0.761
8                                          0.748
9                                          0.747

   Positive_Future_Percentage_Post_-0.5_Drawdown  \
0                                          0.544
1                                          0.563
2                                          0.597
3                                          0.639
4                                          0.665
5                                          0.709
6                                          0.750
7                                          0.762
8                                          0.748
9                                          0.748

   Positive_Future_Percentage_Post_-0.6_Drawdown  \
0                                          0.545
1                                          0.565
2                                          0.599
3                                          0.643
4                                          0.668
5                                          0.712
6                                          0.754
7                                          0.766
8                                          0.750
9                                          0.750

   Positive_Future_Percentage_Post_-0.7_Drawdown  \
0                                          0.543
1                                          0.565
2                                          0.600
3                                          0.651
4                                          0.689
5                                          0.728
6                                          0.780
7                                          0.781
8                                          0.756
```

```
9                                           0.762

   Positive_Future_Percentage_Post_-0.8_Drawdown
0                                           0.544
1                                           0.564
2                                           0.599
3                                           0.648
4                                           0.684
5                                           0.744
6                                           0.802
7                                           0.782
8                                           0.755
9                                           0.764
```

[38]:

```
plot_scatter(
    df=rolling_returns_positive_future_returns,
    x_plot_column="Period",
    y_plot_columns=[col for col in rolling_returns_positive_future_returns.
 ↪columns if col != "Period"],
    title="TQQQ Future Return by Time Period Post Drawdown",
    x_label="Rolling Return Time Period",
    x_format="String",
    x_format_decimal_places=0,
    x_tick_spacing=1,
    x_tick_rotation=0,
    y_label="Positive Future Return Percentage",
    y_format="Decimal",
    y_format_decimal_places=2,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=False,
    OLS_column=None,
    plot_Ridge_regression_line=False,
    Ridge_column=None,
    plot_RidgeCV_regression_line=False,
    RidgeCV_column=None,
    regression_constant=False,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



This plot summarizes the future rolling returns well. For rolling returns up to ~3 months *following* all drawdown levels, we see the rolling returns of TQQQ are positive ~65% of the time.

As we extend the time horizon, the percentage of positive rolling returns increases, which is consistent with the idea that the longer you hold through and post drawdown, the more likely you are to recover and achieve positive returns.

From a timing standpoint, this analysis suggests that the optimal time to buy TQQQ would be following a drawdown of 70% or more, and holding for at least 3 years. The data tells us that having a positive rolling return over time is ~75%.

One might consider the idea of allocating to TQQQ via a ladder, starting at a drawdown of 50%, and continuing to add to the position as the drawdown deepens, with the idea that the more severe the drawdown, the higher the expected future returns. However, this strategy could require enduring significant volatility, as one would be adding to the position during periods of paper losses.

0.5 SPY & UPRO

Next, we will repeat the same analysis for SPY and UPRO, and see how the results compare to those of QQQ and TQQQ.

0.5.1 Acquire & Plot Data (SPY)

First, let's get the data for SPY. If we already have the desired data, we can load it from a local file. Otherwise, we can download it from Yahoo Finance using the `yf_pull_data` function.

[39]:
```
yf_pull_data(
    base_directory=DATA_DIR,
```

```python
    ticker="SPY",
    adjusted=False,
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    excel_export=True,
    pickle_export=True,
    output_confirmation=False,
)

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

# Rename columns to "SPY_Close", etc.
spy = spy.rename(columns={
    "Adj Close": "SPY_Adj_Close",
    "Close": "SPY_Close",
    "High": "SPY_High",
    "Low": "SPY_Low",
    "Open": "SPY_Open",
    "Volume": "SPY_Volume"
})
```

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

This gives us:

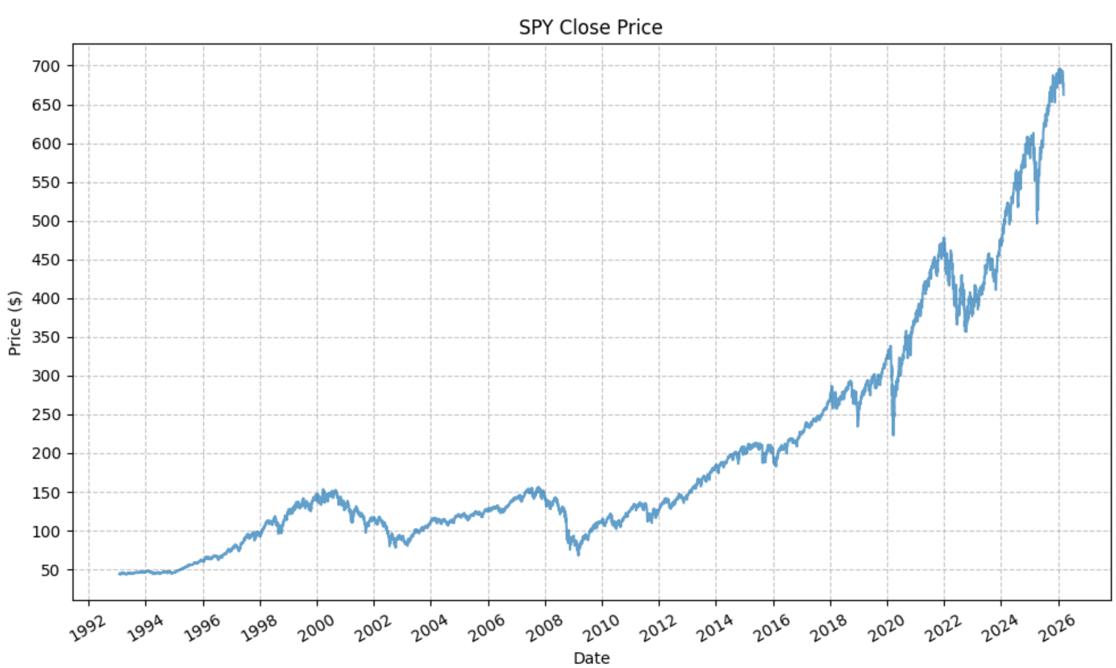
[40]:
```python
display(spy)
```

Date	SPY_Adj_Close	SPY_Close	SPY_High	SPY_Low	SPY_Open	SPY_Volume
1993-01-29	24.241	43.938	43.969	43.750	43.969	1003200
1993-02-01	24.414	44.250	44.250	43.969	43.969	480500
1993-02-02	24.466	44.344	44.375	44.125	44.219	201300
1993-02-03	24.724	44.812	44.844	44.375	44.406	529400
1993-02-04	24.828	45.000	45.094	44.469	44.969	531500
…	…	…	…	…	…	…
2026-03-09	678.270	678.270	679.920	662.390	666.390	102667700
2026-03-10	677.180	677.180	683.360	674.760	677.720	81505300
2026-03-11	676.330	676.330	680.080	673.340	677.580	68441700
2026-03-12	666.060	666.060	671.650	665.870	671.160	108882200
2026-03-13	662.290	662.290	672.340	661.360	669.270	96905100

```
[8337 rows x 6 columns]
```

And the plot of the timseries of ajdusted close prices:

```
[41]: plot_timeseries(
    df=spy,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["SPY_Close"],
    title="SPY Close Price",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=2,
    x_tick_rotation=30,
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=False,
    export_plot=False,
    plot_file_name=None,
)
```



0.5.2 Acquire & Plot Data (UPRO)

Next, UPRO:

[42]:
```
yf_pull_data(
    base_directory=DATA_DIR,
    ticker="UPRO",
    adjusted=False,
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    excel_export=True,
    pickle_export=True,
    output_confirmation=False,
)

upro = load_data(
    base_directory=DATA_DIR,
    ticker="UPRO",
    source="Yahoo_Finance",
    asset_class="Exchange_Traded_Funds",
    timeframe="Daily",
    file_format="pickle",
)

# Rename columns to "UPRO_Close", etc.
upro = upro.rename(columns={
    "Adj Close": "UPRO_Adj_Close",
    "Close": "UPRO_Close",
    "High": "UPRO_High",
    "Low": "UPRO_Low",
    "Open": "UPRO_Open",
    "Volume": "UPRO_Volume"
})
```

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

This gives us:

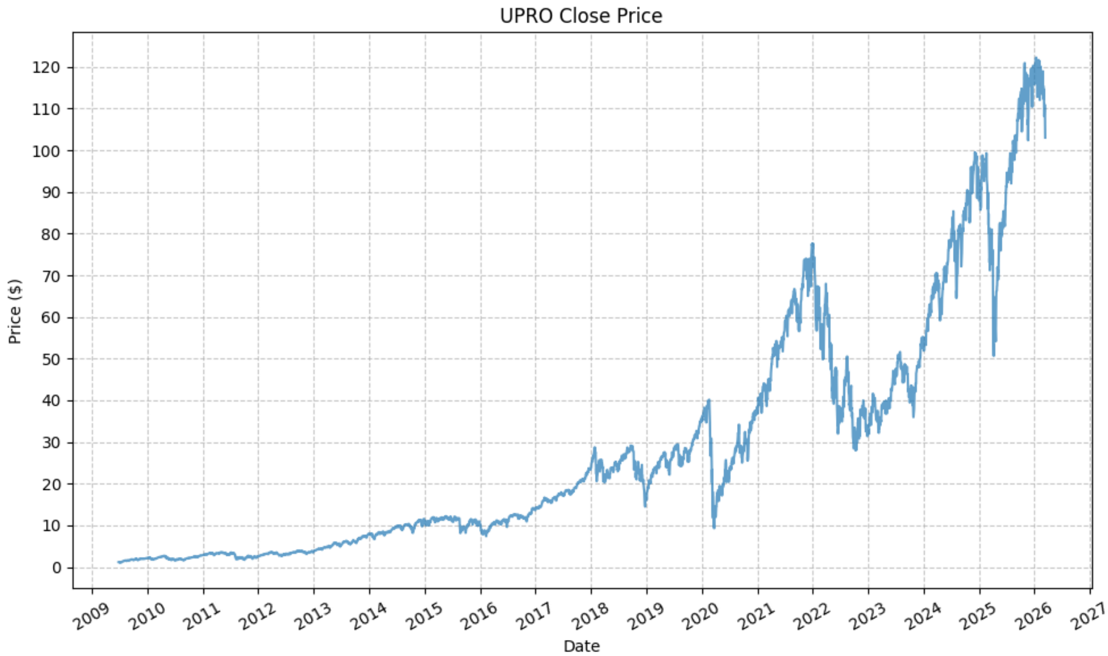
[43]:
```
display(upro)
```

```
            UPRO_Adj_Close  UPRO_Close  UPRO_High  UPRO_Low  UPRO_Open  \
Date
2009-06-25           1.135       1.206      1.210     1.126      1.126
2009-06-26           1.129       1.199      1.213     1.177      1.195
2009-06-29           1.161       1.233      1.236     1.191      1.208
2009-06-30           1.133       1.204      1.243     1.176      1.233
2009-07-01           1.145       1.217      1.253     1.214      1.218
…                        …           …          …         …          …
```

```
2026-03-09          110.970     110.970     111.740    103.270     105.200
2026-03-10          110.310     110.310     113.410    109.210     110.650
2026-03-11          109.940     109.940     111.760    108.490     110.540
2026-03-12          104.890     104.890     107.620    104.800     107.350
2026-03-13          103.010     103.010     107.760    102.600     106.300

            UPRO_Volume
Date
2009-06-25      2577600
2009-06-26     13104000
2009-06-29      8690400
2009-06-30     17128800
2009-07-01     12038400
…                  …
2026-03-09      9101400
2026-03-10      6155700
2026-03-11      4181000
2026-03-12      6085600
2026-03-13      6577000

[4205 rows x 6 columns]
```

And the plot of the timseries of ajdusted close prices:

[44]:
```python
plot_timeseries(
    df=upro,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["UPRO_Close"],
    title="UPRO Close Price",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=1,
    x_tick_rotation=30,
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=False,
    export_plot=False,
    plot_file_name=None,
)
```



Looking at the close prices doesn't give us a true picture of the magnitude of the difference in returns due to the leverage. In order to see that, we need to look at the cumulative returns and the drawdowns.

Calculate & Plot Cumulative Returns, Rolling Returns, and Drawdowns (SPY & UPRO)

Next, we will calculate the cumulative returns, rolling returns, and drawdowns. This involves aligning the data to start with the inception of UPRO. For this excercise, we will not extrapolate the data for SPY back to 1993, but rather just align the data from the inception of UPRO in 2009.

[45]:
```
etfs = ["SPY", "UPRO"]

# Merge dataframes and drop rows with missing values
spy_upro_aligned = upro.merge(spy, left_index=True, right_index=True,␣
↪how='left')
spy_upro_aligned = spy_upro_aligned.dropna()

# Calculate cumulative returns
for etf in etfs:
    spy_upro_aligned[f"{etf}_Return"] = spy_upro_aligned[f"{etf}_Close"].
↪pct_change()
    spy_upro_aligned[f"{etf}_Cumulative_Return"] = (1 +␣
↪spy_upro_aligned[f"{etf}_Return"]).cumprod() - 1
    spy_upro_aligned[f"{etf}_Cumulative_Return_Plus_One"] = 1 +␣
↪spy_upro_aligned[f"{etf}_Cumulative_Return"]
```

```
    spy_upro_aligned[f"{etf}_Rolling_Max"] =␣
↪spy_upro_aligned[f"{etf}_Cumulative_Return_Plus_One"].cummax()
    spy_upro_aligned[f"{etf}_Drawdown"] =␣
↪spy_upro_aligned[f"{etf}_Cumulative_Return_Plus_One"] /␣
↪spy_upro_aligned[f"{etf}_Rolling_Max"] - 1
    spy_upro_aligned.drop(columns=[f"{etf}_Cumulative_Return_Plus_One",␣
↪f"{etf}_Rolling_Max"], inplace=True)

# Define rolling windows in trading days
rolling_windows = {
    '1d': 1,       # 1 day
    '1w': 5,       # 1 week (5 trading days)
    '1m': 21,      # 1 month (~21 trading days)
    '3m': 63,      # 3 months (~63 trading days)
    '6m': 126,     # 6 months (~126 trading days)
    '1y': 252,     # 1 year (~252 trading days)
    '2y': 504,     # 2 years (~504 trading days)
    '3y': 756,     # 3 years (~756 trading days)
    '4y': 1008,    # 4 years (~1008 trading days)
    '5y': 1260,    # 5 years (~1260 trading days)
}

# Calculate rolling returns for each ETF and each window
for etf in etfs:
    for period_name, window in rolling_windows.items():
        spy_upro_aligned[f"{etf}_Rolling_Return_{period_name}"] = (
            spy_upro_aligned[f"{etf}_Close"].pct_change(periods=window)
        )
```

[46]:
```
display(spy_upro_aligned)
```

```
            UPRO_Adj_Close  UPRO_Close  UPRO_High  UPRO_Low  UPRO_Open  \
Date
2009-06-25           1.135       1.206      1.210     1.126      1.126
2009-06-26           1.129       1.199      1.213     1.177      1.195
2009-06-29           1.161       1.233      1.236     1.191      1.208
2009-06-30           1.133       1.204      1.243     1.176      1.233
2009-07-01           1.145       1.217      1.253     1.214      1.218
…                        …           …          …         …          …
2026-03-09         110.970     110.970    111.740   103.270    105.200
2026-03-10         110.310     110.310    113.410   109.210    110.650
2026-03-11         109.940     109.940    111.760   108.490    110.540
2026-03-12         104.890     104.890    107.620   104.800    107.350
2026-03-13         103.010     103.010    107.760   102.600    106.300

            UPRO_Volume  SPY_Adj_Close  SPY_Close  SPY_High  SPY_Low  …  \
Date                                                                  …
```

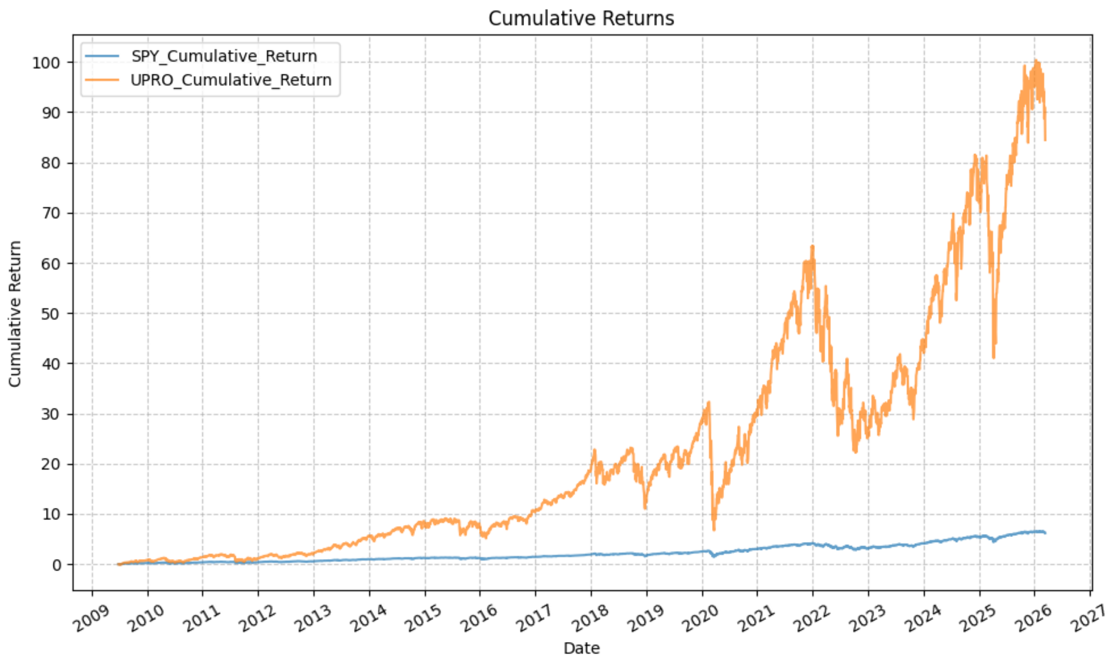
```
2009-06-25      2577600        68.389     92.080    92.170   89.570  …
2009-06-26     13104000        68.211     91.840    92.240   91.270  …
2009-06-29      8690400        68.850     92.700    92.820   91.600  …
2009-06-30     17128800        68.293     91.950    93.060   91.270  …
2009-07-01     12038400        68.575     92.330    93.230   92.210  …
…                   …          …        …       …        …  …
2026-03-09      9101400       678.270    678.270   679.920  662.390  …
2026-03-10      6155700       677.180    677.180   683.360  674.760  …
2026-03-11      4181000       676.330    676.330   680.080  673.340  …
2026-03-12      6085600       666.060    666.060   671.650  665.870  …
2026-03-13      6577000       662.290    662.290   672.340  661.360  …

            UPRO_Rolling_Return_1d  UPRO_Rolling_Return_1w  \
Date
2009-06-25                     NaN                     NaN
2009-06-26                  -0.005                     NaN
2009-06-29                   0.028                     NaN
2009-06-30                  -0.024                     NaN
2009-07-01                   0.011                     NaN
…                              …                     …
2026-03-09                   0.026                  -0.038
2026-03-10                  -0.006                  -0.017
2026-03-11                  -0.003                  -0.041
2026-03-12                  -0.046                  -0.069
2026-03-13                  -0.018                  -0.048

            UPRO_Rolling_Return_1m  UPRO_Rolling_Return_3m  \
Date
2009-06-25                     NaN                     NaN
2009-06-26                     NaN                     NaN
2009-06-29                     NaN                     NaN
2009-06-30                     NaN                     NaN
2009-07-01                     NaN                     NaN
…                              …                     …
2026-03-09                  -0.009                  -0.056
2026-03-10                  -0.069                  -0.065
2026-03-11                  -0.085                  -0.060
2026-03-12                  -0.120                  -0.101
2026-03-13                  -0.134                  -0.133

            UPRO_Rolling_Return_6m  UPRO_Rolling_Return_1y  \
Date
2009-06-25                     NaN                     NaN
2009-06-26                     NaN                     NaN
2009-06-29                     NaN                     NaN
2009-06-30                     NaN                     NaN
2009-07-01                     NaN                     NaN
…                              …                     …
```

```
2026-03-09                    0.084                   0.383
2026-03-10                    0.069                   0.355
2026-03-11                    0.059                   0.467
2026-03-12                    0.001                   0.435
2026-03-13                   -0.040                   0.389

            UPRO_Rolling_Return_2y  UPRO_Rolling_Return_3y  \
Date
2009-06-25                     NaN                     NaN
2009-06-26                     NaN                     NaN
2009-06-29                     NaN                     NaN
2009-06-30                     NaN                     NaN
2009-07-01                     NaN                     NaN
…                                …                       …
2026-03-09                   0.668                   2.110
2026-03-10                   0.710                   1.952
2026-03-11                   0.679                   1.933
2026-03-12                   0.556                   1.934
2026-03-13                   0.557                   1.869

            UPRO_Rolling_Return_4y  UPRO_Rolling_Return_5y
Date
2009-06-25                     NaN                     NaN
2009-06-26                     NaN                     NaN
2009-06-29                     NaN                     NaN
2009-06-30                     NaN                     NaN
2009-07-01                     NaN                     NaN
…                                …                       …
2026-03-09                   1.007                   1.656
2026-03-10                   0.893                   1.748
2026-03-11                   0.914                   1.847
2026-03-12                   0.872                   1.573
2026-03-13                   1.017                   1.565

[4205 rows x 38 columns]
```

And now the plot for the cumulative returns:

[47]:
```python
plot_timeseries(
    df=spy_upro_aligned,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["SPY_Cumulative_Return", "UPRO_Cumulative_Return"],
    title="Cumulative Returns",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=1,
    x_tick_rotation=30,
```

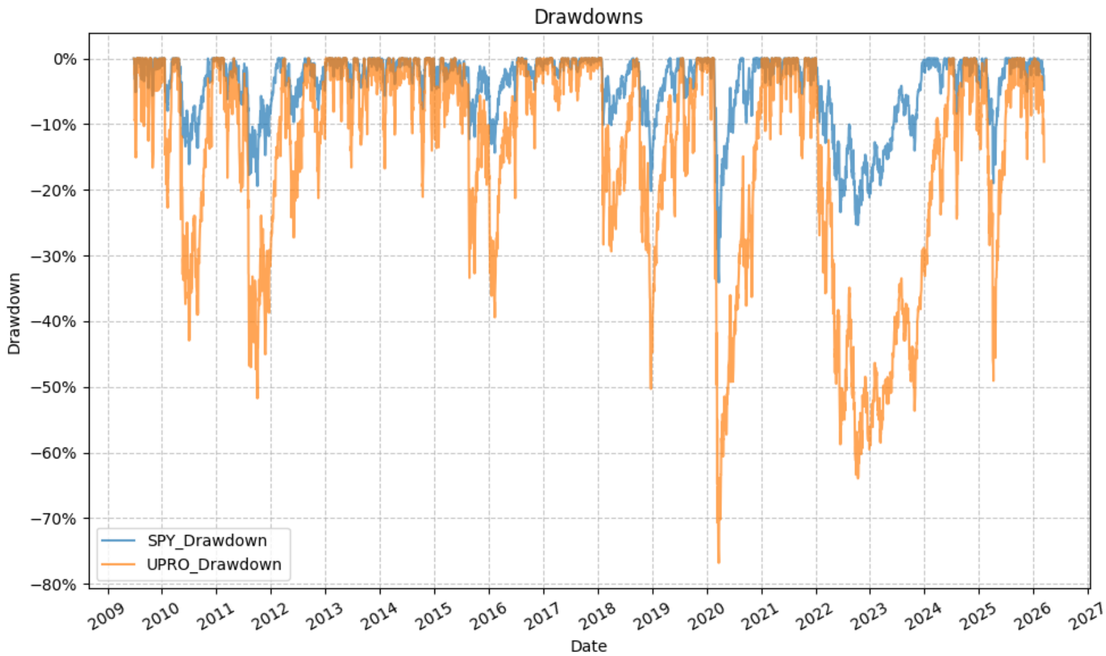
```
    y_label="Cumulative Return",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



And the drawdown plot:

[48]:
```
plot_timeseries(
    df=spy_upro_aligned,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["SPY_Drawdown", "UPRO_Drawdown"],
    title="Drawdowns",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=1,
    x_tick_rotation=30,
    y_label="Drawdown",
    y_format="Percentage",
    y_format_decimal_places=0,
```

```
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



0.5.3 Summary Statistics (SPY & UPRO)

Looking at the summary statistics further confirms our intuitions about the volatility and drawdowns.

[49]:
```
spy_sum_stats = summary_stats(
    fund_list=["SPY"],
    df=spy_upro_aligned[["SPY_Return"]],
    period="Daily",
    use_calendar_days=False,
    excel_export=False,
    pickle_export=False,
    output_confirmation=False,
)

upro_sum_stats = summary_stats(
    fund_list=["UPRO"],
```

```
    df=spy_upro_aligned[["UPRO_Return"]],
    period="Daily",
    use_calendar_days=False,
    excel_export=False,
    pickle_export=False,
    output_confirmation=False,
)

sum_stats = pd.concat([spy_sum_stats, upro_sum_stats])

display(sum_stats)
```

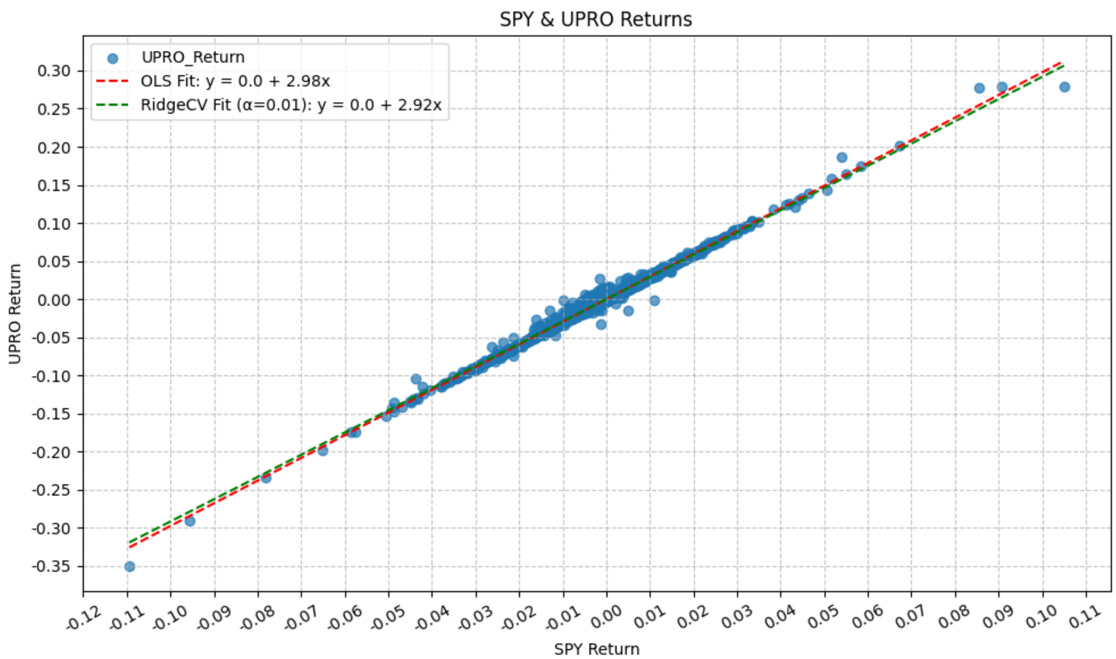
```
             Annual Mean Return (Arithmetic)  Annualized Volatility  \
SPY_Return                             0.133                  0.172
UPRO_Return                            0.400                  0.513

             Annualized Sharpe Ratio  CAGR (Geometric)  Daily Max Return  \
SPY_Return                     0.774             0.126             0.105
UPRO_Return                    0.780             0.305             0.280

            Daily Max Return (Date)  Daily Min Return Daily Min Return (Date)  \
SPY_Return               2025-04-09            -0.109              2020-03-16
UPRO_Return              2020-03-24            -0.349              2020-03-16

             Max Drawdown       Peak     Trough Recovery Date  \
SPY_Return         -0.341 2020-02-19 2020-03-23    2020-08-18
UPRO_Return        -0.768 2020-02-19 2020-03-23    2021-01-08

             Days to Recovery  MAR Ratio
SPY_Return                148      0.368
UPRO_Return               291      0.398
```

0.5.4 Plot Returns & Verify Beta (SPY & UPRO)

Before we look at the rolling returns, let us first verify that the daily returns for UPRO are in fact ~3x those of SPY.

[50]:
```
plot_scatter(
    df=spy_upro_aligned,
    x_plot_column="SPY_Return",
    y_plot_columns=["UPRO_Return"],
    title="SPY & UPRO Returns",
    x_label="SPY Return",
    x_format="Decimal",
    x_format_decimal_places=2,
    x_tick_spacing="Auto",
    x_tick_rotation=30,
    y_label="UPRO Return",
```

```
    y_format="Decimal",
    y_format_decimal_places=2,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=True,
    OLS_column="UPRO_Return",
    plot_Ridge_regression_line=False,
    Ridge_column=None,
    plot_RidgeCV_regression_line=True,
    RidgeCV_column="UPRO_Return",
    regression_constant=True,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



[51]:
```
model = run_linear_regression(
    df=spy_upro_aligned,
    x_plot_column="SPY_Return",
    y_plot_column="UPRO_Return",
    regression_model="OLS-statsmodels",
    regression_constant=True,
)
```

```
print(model.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:            UPRO_Return   R-squared:                       0.994
Model:                            OLS   Adj. R-squared:                  0.994
Method:                 Least Squares   F-statistic:                 6.745e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):               0.00
Time:                        14:27:52   Log-Likelihood:                 19150.
No. Observations:                4204   AIC:                        -3.830e+04
Df Residuals:                    4202   BIC:                        -3.828e+04
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const       1.711e-05   3.93e-05      0.436      0.663   -5.99e-05    9.41e-05
SPY_Return     2.9760      0.004    821.252      0.000       2.969       2.983
==============================================================================
Omnibus:                     2680.692   Durbin-Watson:                   2.590
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           517107.129
Skew:                           1.986   Prob(JB):                         0.00
Kurtosis:                      57.188   Cond. No.                         92.3
==============================================================================

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

Visually, this plot makes sense and we can see that there is a strong clustering of points, but we double check with the regression, regressing the UPRO daily return (y) on the SPY daily return (X).

0.5.5 Extrapolate Data (SPY & UPRO)

We will now extrapolate the returns of SPY to backfill the data from the inception of SPY in 1993 to the inception of UPRO in 2009. For this, we'll use the coefficient of 2.98 that we found in the regression results above.

[52]:
```
# Set leverage multiplier based on regression coefficient
LEVERAGE_MULTIPLIER = model.params[1]

# Merge dataframes and extrapolate return values for SPY back to 1993 using the
↪leverage multiplier
spy_upro_extrap = spy[["SPY_Close"]].merge(upro[["UPRO_Close"]],
↪left_index=True, right_index=True, how='left')

etfs = ["SPY", "UPRO"]
```

```
# Calculate cumulative returns
for etf in etfs:
    spy_upro_extrap[f"{etf}_Return"] = spy_upro_extrap[f"{etf}_Close"].
 ↪pct_change()

# Extrapolate UPRO returns for missing values
spy_upro_extrap["UPRO_Return"] = spy_upro_extrap["UPRO_Return"].
 ↪fillna(LEVERAGE_MULTIPLIER * spy_upro_extrap["SPY_Return"])

# Find the first valid UPRO_Close index and value
first_valid_idx = spy_upro_extrap['UPRO_Close'].first_valid_index()
print(first_valid_idx)
first_valid_price = spy_upro_extrap.loc[first_valid_idx, 'UPRO_Close']
print(first_valid_price)
```

```
2009-06-25 00:00:00
1.205556035041809
```

Before we extrapolate, let's first look at the data we have for SPY and UPRO around the inception of UPRO in 2009:

[53]:
```
# Check values around the first valid index
print(spy_upro_extrap.loc["2009-06-20":"2009-06-30"])
```

```
            SPY_Close  UPRO_Close  SPY_Return  UPRO_Return
Date
2009-06-22     89.280         NaN      -0.030       -0.089
2009-06-23     89.350         NaN       0.001        0.002
2009-06-24     90.120         NaN       0.009        0.026
2009-06-25     92.080       1.206       0.022        0.065
2009-06-26     91.840       1.199      -0.003       -0.005
2009-06-29     92.700       1.233       0.009        0.028
2009-06-30     91.950       1.204      -0.008       -0.024
```

Now, backfill the data for the UPRO close price:

[54]:
```
# Iterate through the dataframe backwards
for i in range(spy_upro_extrap.index.get_loc(first_valid_idx) - 1, -1, -1):

    # The return that led to the price the next day
    current_return = spy_upro_extrap.iloc[i + 1]['UPRO_Return']

    # Get the next day's price
    next_price = spy_upro_extrap.iloc[i + 1]['UPRO_Close']

    # Price_{t} = Price_{t+1} / (1 + Return_{t})
    spy_upro_extrap.loc[spy_upro_extrap.index[i], 'UPRO_Close'] = next_price /␣
 ↪(1 + current_return)
```

Finally, confirm the values are correct:

[55]:
```python
# Confirm values around the first valid index after extrapolation
print(spy_upro_extrap.loc["2009-06-20":"2009-06-30"])
```

```
            SPY_Close  UPRO_Close  SPY_Return  UPRO_Return
Date
2009-06-22     89.280       1.101      -0.030       -0.089
2009-06-23     89.350       1.104       0.001        0.002
2009-06-24     90.120       1.132       0.009        0.026
2009-06-25     92.080       1.206       0.022        0.065
2009-06-26     91.840       1.199      -0.003       -0.005
2009-06-29     92.700       1.233       0.009        0.028
2009-06-30     91.950       1.204      -0.008       -0.024
```

And the complete DataFrame with the extrapolated values:

[56]:
```python
display(spy_upro_extrap)
```

```
            SPY_Close  UPRO_Close  SPY_Return  UPRO_Return
Date
1993-01-29     43.938       0.926         NaN          NaN
1993-02-01     44.250       0.945       0.007        0.021
1993-02-02     44.344       0.951       0.002        0.006
1993-02-03     44.812       0.981       0.011        0.031
1993-02-04     45.000       0.993       0.004        0.012
…                …           …         …          …
2026-03-09    678.270     110.970       0.009        0.026
2026-03-10    677.180     110.310      -0.002       -0.006
2026-03-11    676.330     109.940      -0.001       -0.003
2026-03-12    666.060     104.890      -0.015       -0.046
2026-03-13    662.290     103.010      -0.006       -0.018

[8337 rows x 4 columns]
```

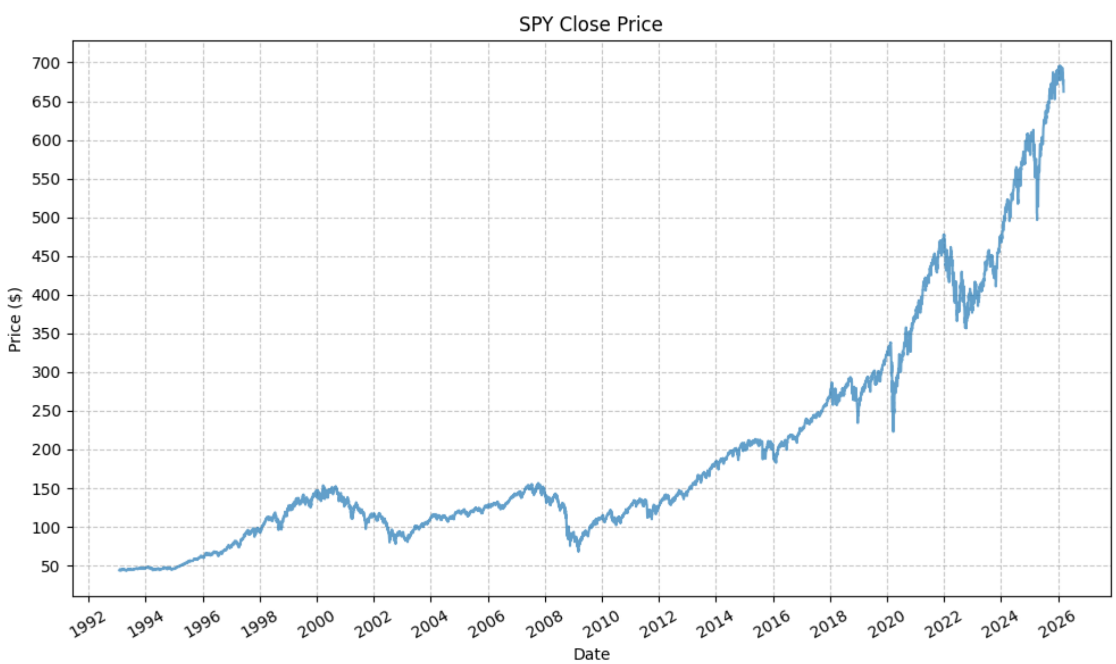
After the extrapolation, we now have the following plots for the prices, cumulative returns, and drawdowns:

[57]:
```python
etfs = ["SPY", "UPRO"]

# Calculate cumulative returns
for etf in etfs:
    spy_upro_extrap[f"{etf}_Return"] = spy_upro_extrap[f"{etf}_Close"].
 ↪pct_change()
    spy_upro_extrap[f"{etf}_Cumulative_Return"] = (1 +␣
 ↪spy_upro_extrap[f"{etf}_Return"]).cumprod() - 1
    spy_upro_extrap[f"{etf}_Cumulative_Return_Plus_One"] = 1 +␣
 ↪spy_upro_extrap[f"{etf}_Cumulative_Return"]
```

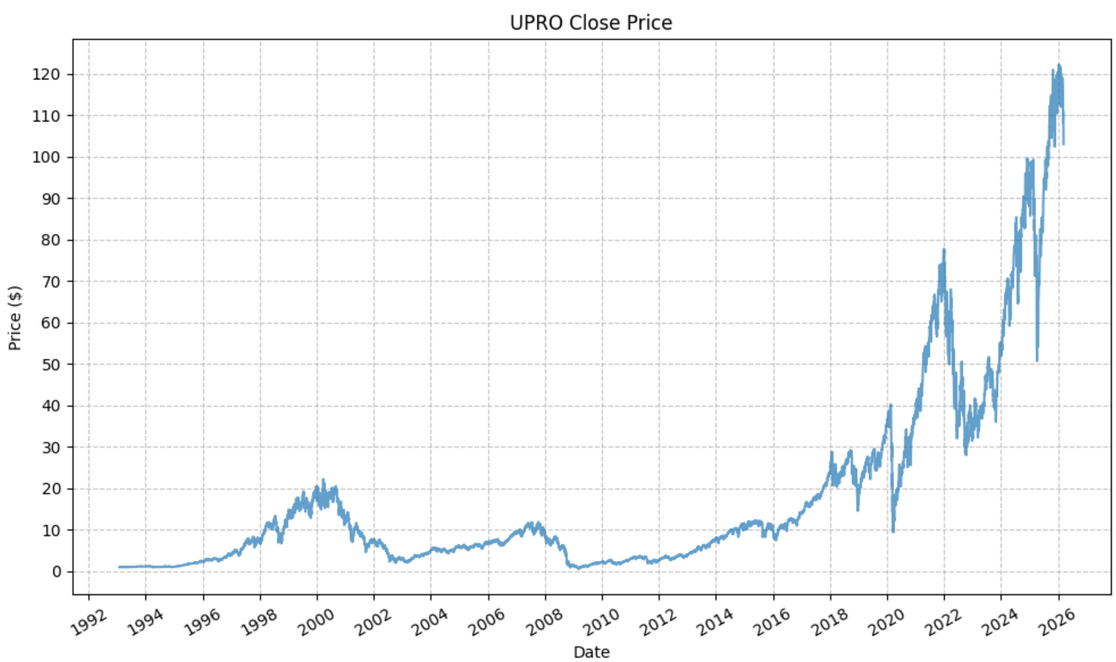
```
    spy_upro_extrap[f"{etf}_Rolling_Max"] =␣
↪spy_upro_extrap[f"{etf}_Cumulative_Return_Plus_One"].cummax()
    spy_upro_extrap[f"{etf}_Drawdown"] =␣
↪spy_upro_extrap[f"{etf}_Cumulative_Return_Plus_One"] /␣
↪spy_upro_extrap[f"{etf}_Rolling_Max"] - 1
    spy_upro_extrap.drop(columns=[f"{etf}_Cumulative_Return_Plus_One",␣
↪f"{etf}_Rolling_Max"], inplace=True)
```

[58]:

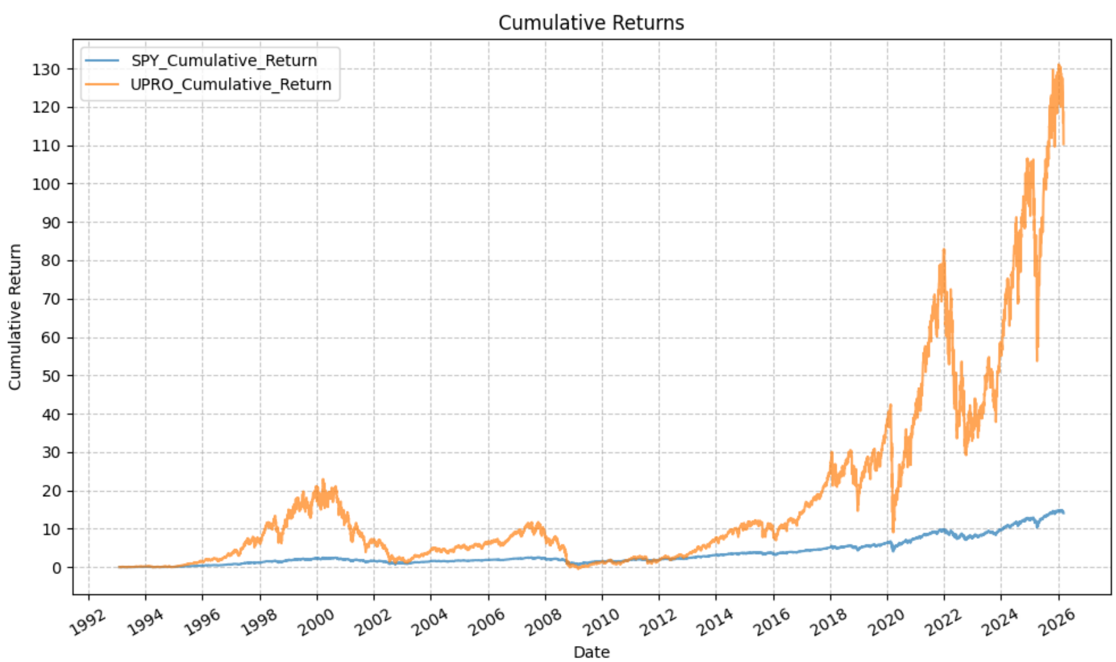
```
plot_timeseries(
    df=spy_upro_extrap,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["SPY_Close"],
    title="SPY Close Price",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=2,
    x_tick_rotation=30,
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=False,
    export_plot=False,
    plot_file_name=None,
)
```



[59]:
```
plot_timeseries(
    df=spy_upro_extrap,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["UPRO_Close"],
    title="UPRO Close Price",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=2,
    x_tick_rotation=30,
    y_label="Price ($)",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=False,
    export_plot=False,
    plot_file_name=None,
)
```

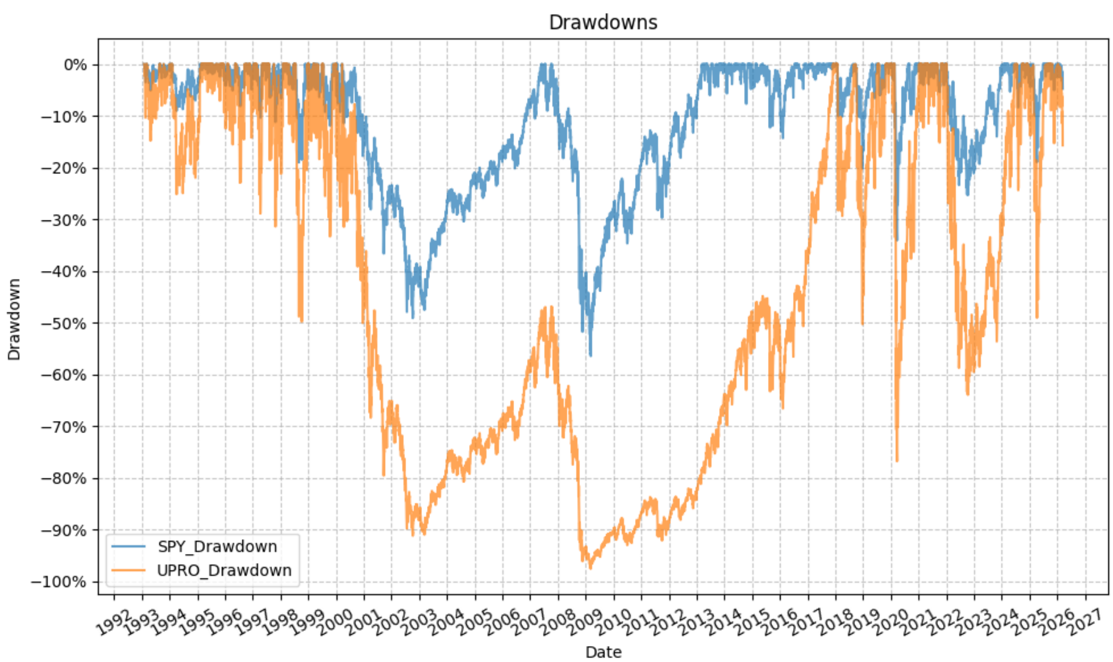


[60]:
```
plot_timeseries(
    df=spy_upro_extrap,
    plot_start_date=None,
    plot_end_date=None,
    plot_columns=["SPY_Cumulative_Return", "UPRO_Cumulative_Return"],
    title="Cumulative Returns",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=2,
    x_tick_rotation=30,
    y_label="Cumulative Return",
    y_format="Decimal",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



[61]:
```
plot_timeseries(
    df=spy_upro_extrap,
    plot_start_date=None,
    plot_end_date=None,
```

```python
    plot_columns=["SPY_Drawdown", "UPRO_Drawdown"],
    title="Drawdowns",
    x_label="Date",
    x_format="Year",
    x_tick_spacing=1,
    x_tick_rotation=30,
    y_label="Drawdown",
    y_format="Percentage",
    y_format_decimal_places=0,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



Interestingly, the drawdown for UPRO is not nearly as severe as that of TQQQ, which may be due to the fact that SPY has not had the same extreme return profile as QQQ over the past 15 years. This highlights the importance of the underlying asset's return profile on the performance of leveraged ETFs.

0.5.6 Plot Rolling Returns (SPY & UPRO)

Next, we will consider the following:

- Histogram and scatter plots of the rolling returns of SPY and UPRO

- Regressions to establish a "leverage factor" for the rolling returns
- The deviation from a 3x return for each time period

For this set of regressions, we will also allow the constant. First, we need the rolling returns for various time periods:

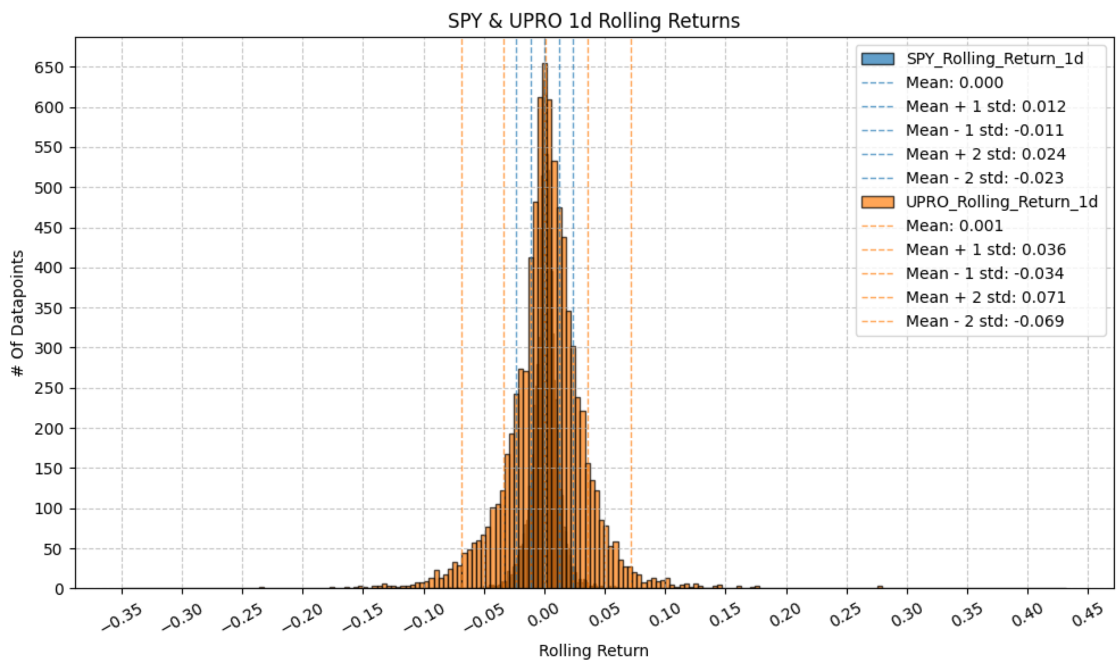
[62]:
```python
# Define rolling windows in trading days
rolling_windows = {
    '1d': 1,       # 1 day
    '1w': 5,       # 1 week (5 trading days)
    '1m': 21,      # 1 month (~21 trading days)
    '3m': 63,      # 3 months (~63 trading days)
    '6m': 126,     # 6 months (~126 trading days)
    '1y': 252,     # 1 year (~252 trading days)
    '2y': 504,     # 2 years (~504 trading days)
    '3y': 756,     # 3 years (~756 trading days)
    '4y': 1008,    # 4 years (~1008 trading days)
    '5y': 1260,    # 5 years (~1260 trading days)
}

# Calculate rolling returns for each ETF and each window
for etf in etfs:
    for period_name, window in rolling_windows.items():
        spy_upro_extrap[f"{etf}_Rolling_Return_{period_name}"] = (
            spy_upro_extrap[f"{etf}_Close"].pct_change(periods=window)
        )
```

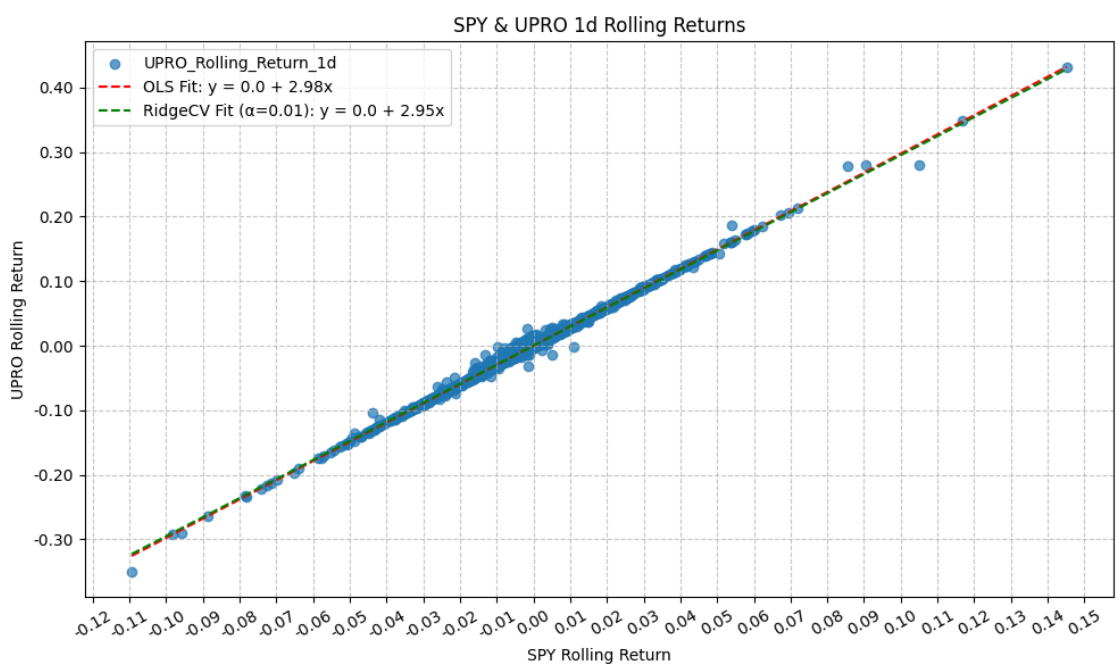
This gives us the following series of histograms, scatter plots, and regression model results:

[63]:
```python
# Create a dataframe to hold rolling returns stats
rolling_returns_stats = pd.DataFrame()

for period_name, window in rolling_windows.items():
    plot_histogram(
        df=spy_upro_extrap,
        plot_columns=[f"SPY_Rolling_Return_{period_name}",␣
 ↪f"UPRO_Rolling_Return_{period_name}"],
        title=f"SPY & UPRO {period_name} Rolling Returns",
        x_label="Rolling Return",
        x_tick_spacing="Auto",
        x_tick_rotation=30,
        y_label="# Of Datapoints",
        y_tick_spacing="Auto",
        y_tick_rotation=0,
        grid=True,
        legend=True,
        export_plot=False,
        plot_file_name=None,
```

```
)

plot_scatter(
    df=spy_upro_extrap,
    x_plot_column=f"SPY_Rolling_Return_{period_name}",
    y_plot_columns=[f"UPRO_Rolling_Return_{period_name}"],
    title=f"SPY & UPRO {period_name} Rolling Returns",
    x_label="SPY Rolling Return",
    x_format="Decimal",
    x_format_decimal_places=2,
    x_tick_spacing="Auto",
    x_tick_rotation=30,
    y_label="UPRO Rolling Return",
    y_format="Decimal",
    y_format_decimal_places=2,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=True,
    OLS_column=f"UPRO_Rolling_Return_{period_name}",
    plot_Ridge_regression_line=False,
    Ridge_column=None,
    plot_RidgeCV_regression_line=True,
    RidgeCV_column=f"UPRO_Rolling_Return_{period_name}",
    regression_constant=True,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)

# Run OLS regression with statsmodels
model = run_linear_regression(
    df=spy_upro_extrap,
    x_plot_column=f"SPY_Rolling_Return_{period_name}",
    y_plot_column=f"UPRO_Rolling_Return_{period_name}",
    regression_model="OLS-statsmodels",
    regression_constant=True,
)
print(model.summary())

# Add the regression results to the rolling returns stats dataframe
intercept = model.params[0]
intercept_pvalue = model.pvalues[0]   # p-value for Intercept
slope = model.params[1]
slope_pvalue = model.pvalues[1]       # p-value for SPY_Return
r_squared = model.rsquared
```

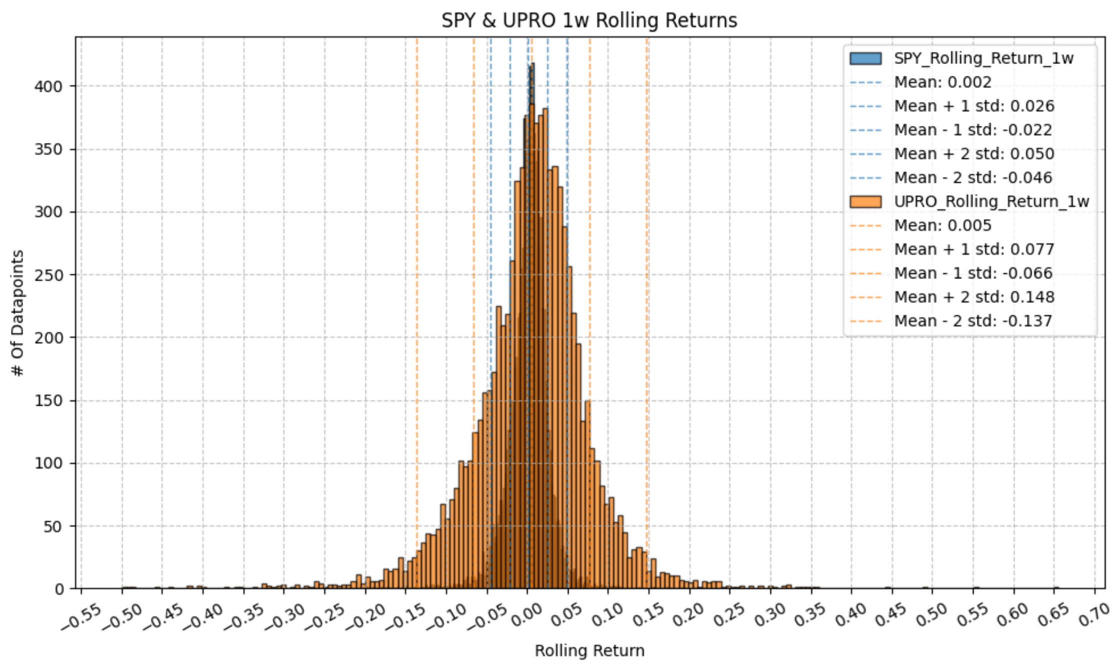
```
    # Calc skew
    return_ratio = spy_upro_extrap[f'UPRO_Rolling_Return_{period_name}'] /␣
↪spy_upro_extrap[f'SPY_Rolling_Return_{period_name}']
    skew = return_ratio.skew()

    # Calc conditional symmetry
    up_markets =␣
↪spy_upro_extrap[spy_upro_extrap[f'SPY_Rolling_Return_{period_name}'] > 0]
    down_markets =␣
↪spy_upro_extrap[spy_upro_extrap[f'SPY_Rolling_Return_{period_name}'] <= 0]

    avg_beta_up = (up_markets[f'UPRO_Rolling_Return_{period_name}'] /␣
↪up_markets[f'SPY_Rolling_Return_{period_name}']).mean()
    avg_beta_down = (down_markets[f'UPRO_Rolling_Return_{period_name}'] /␣
↪down_markets[f'SPY_Rolling_Return_{period_name}']).mean()

    asymmetry = avg_beta_up - avg_beta_down

    rolling_returns_slope_int = pd.DataFrame({
        "Period": period_name,
        "Intercept": [intercept],
        # "Intercept_PValue": [intercept_pvalue],
        "Slope": [slope],
        # "Slope_PValue": [slope_pvalue],
        "R_Squared": [r_squared],
        "Skew": [skew],
        "Average Upside Beta": [avg_beta_up],
        "Average Downside Beta": [avg_beta_down],
        "Asymmetry": [asymmetry]
    })

    rolling_returns_stats = pd.concat([rolling_returns_stats,␣
↪rolling_returns_slope_int])
```

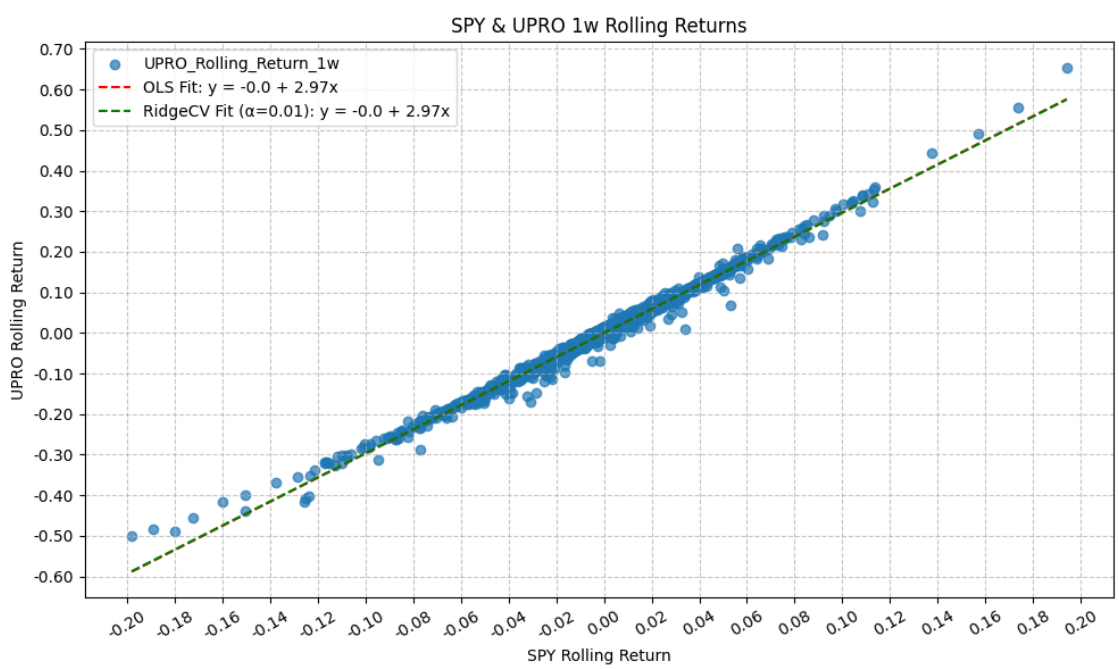





```
                            OLS Regression Results
==============================================================================
==
Dep. Variable:     UPRO_Rolling_Return_1d   R-squared:
```

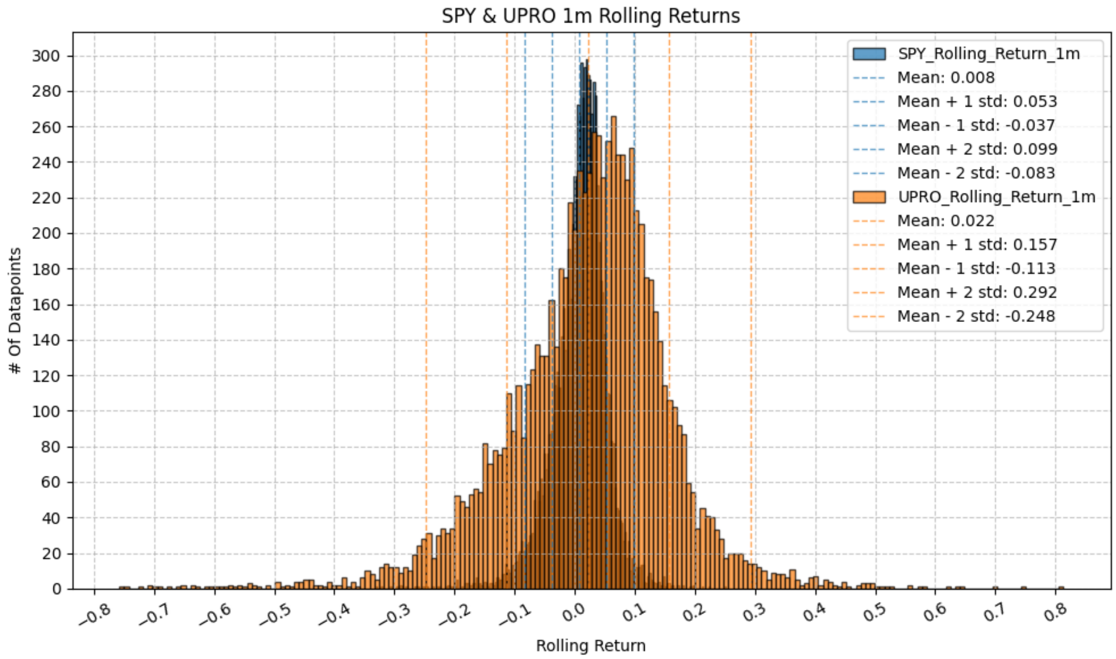
```
0.997
Model:                            OLS   Adj. R-squared:
0.997
Method:                 Least Squares   F-statistic:
3.117e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:55   Log-Likelihood:
40824.
No. Observations:                8336   AIC:
-8.164e+04
Df Residuals:                    8334   BIC:
-8.163e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
=========
                           coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                 8.628e-06   1.98e-05      0.436      0.663   -3.02e-05
4.74e-05
SPY_Rolling_Return_1d    2.9760      0.002   1765.423      0.000       2.973
2.979
==============================================================================
Omnibus:                 6871.164   Durbin-Watson:                   2.591
Prob(Omnibus):              0.000   Jarque-Bera (JB):          4247760.442
Skew:                       2.811   Prob(JB):                         0.00
Kurtosis:                 113.445   Cond. No.                         85.2
==============================================================================

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

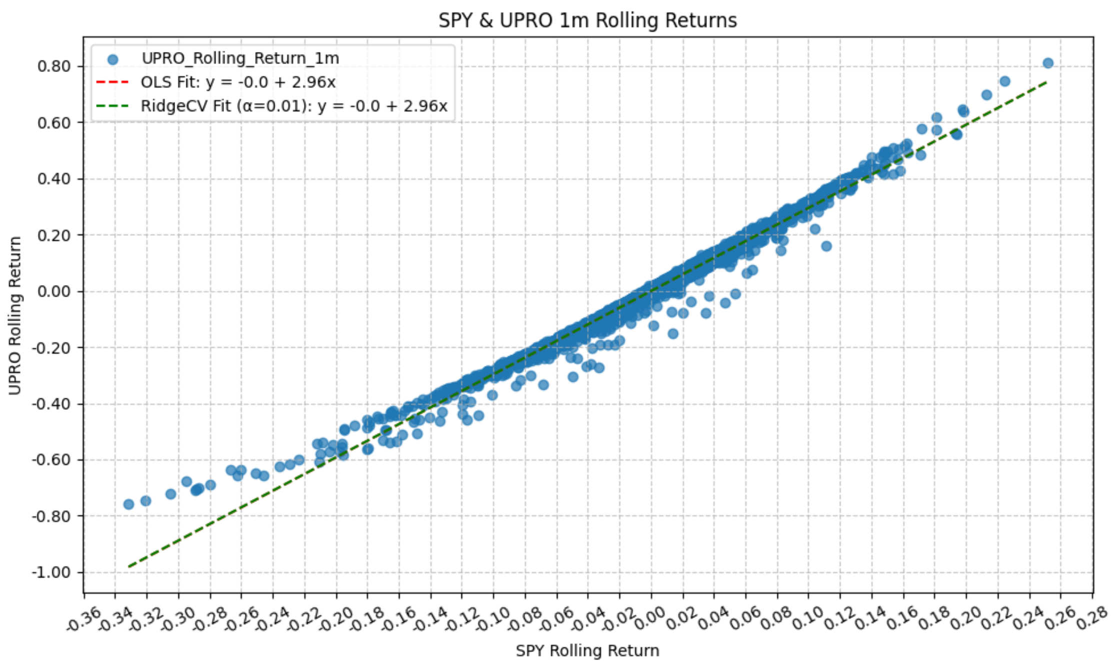





```
                            OLS Regression Results
================================================================================
==
Dep. Variable:      UPRO_Rolling_Return_1w   R-squared:
```

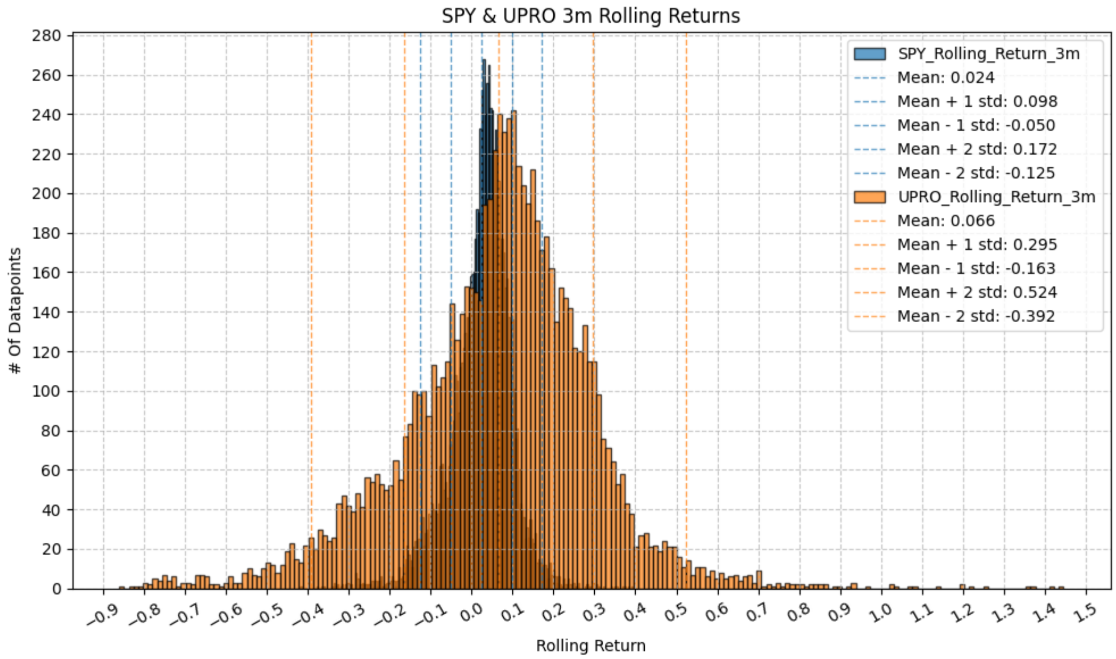
```
0.994
Model:                            OLS   Adj. R-squared:
0.994
Method:                 Least Squares   F-statistic:
1.404e+06
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:56   Log-Likelihood:
31594.
No. Observations:                8332   AIC:
-6.318e+04
Df Residuals:                    8330   BIC:
-6.317e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
=========
                          coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                  -0.0003      6e-05     -4.277      0.000      -0.000
-0.000
SPY_Rolling_Return_1w   2.9725      0.003   1184.942      0.000       2.968
2.977
==============================================================================
Omnibus:                 3741.895   Durbin-Watson:                   0.955
Prob(Omnibus):              0.000   Jarque-Bera (JB):          1489497.909
Skew:                      -0.847   Prob(JB):                         0.00
Kurtosis:                  68.480   Cond. No.                         42.0
==============================================================================

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

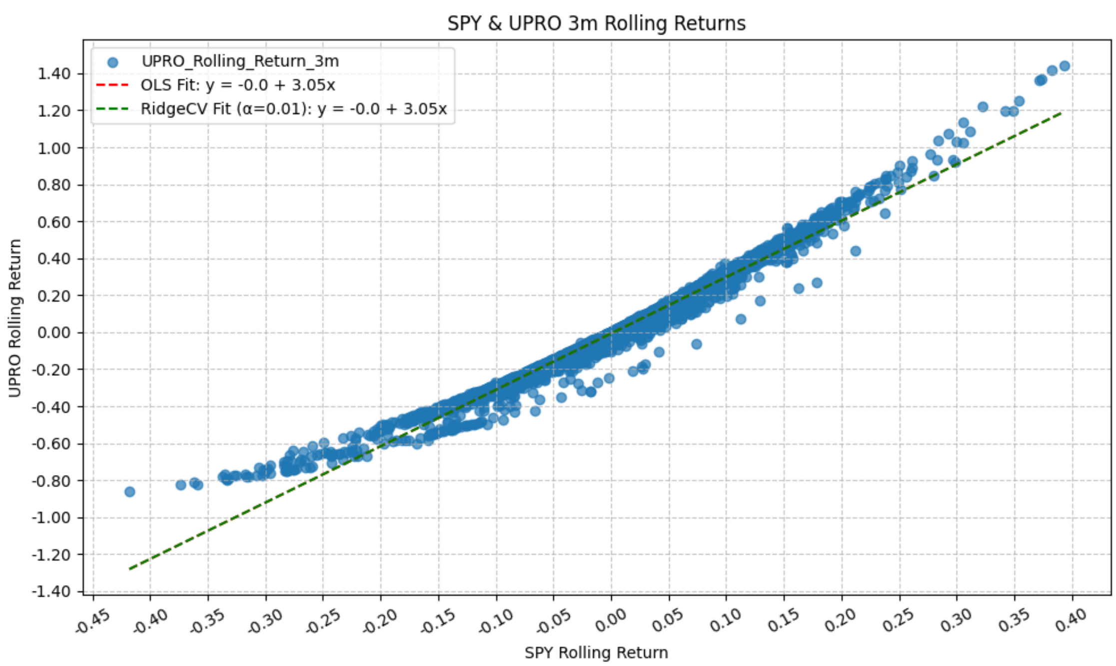





```
                            OLS Regression Results
==============================================================================
==
Dep. Variable:     UPRO_Rolling_Return_1m   R-squared:
```

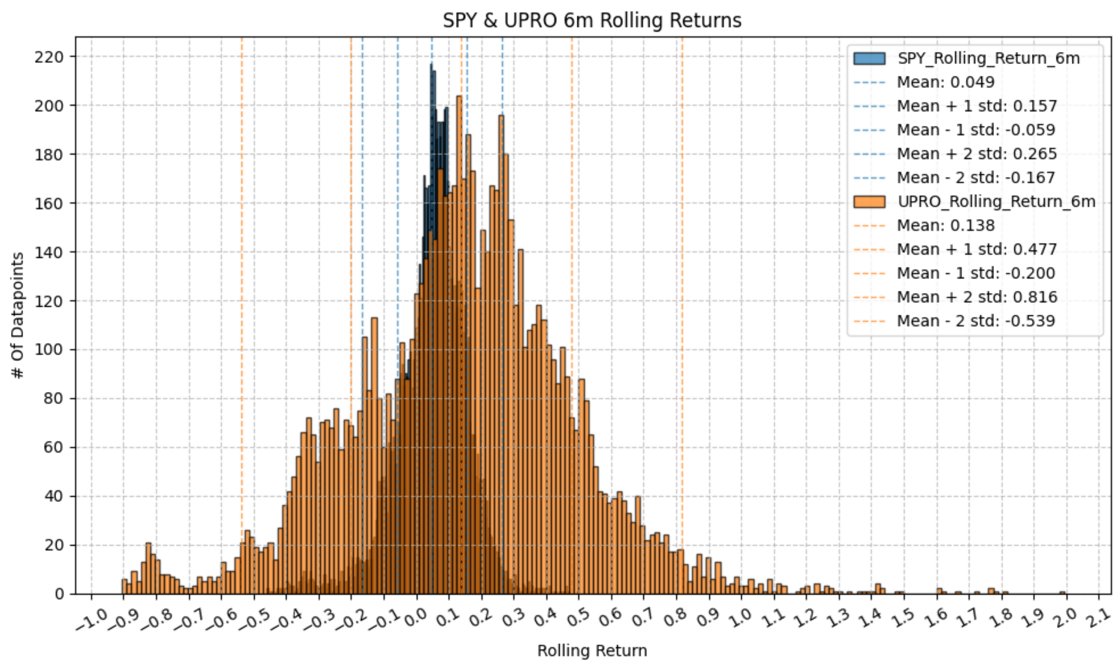
```
0.988
Model:                            OLS   Adj. R-squared:
0.988
Method:                 Least Squares   F-statistic:
6.653e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:58   Log-Likelihood:
23130.
No. Observations:                8316   AIC:
-4.626e+04
Df Residuals:                    8314   BIC:
-4.624e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
=========
                          coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                  -0.0015      0.000     -9.029      0.000      -0.002
-0.001
SPY_Rolling_Return_1m   2.9603      0.004    815.680      0.000       2.953
2.967
==============================================================================
Omnibus:                     2879.641   Durbin-Watson:                   0.314
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           855364.296
Skew:                          -0.291   Prob(JB):                         0.00
Kurtosis:                      52.681   Cond. No.                         22.1
==============================================================================

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

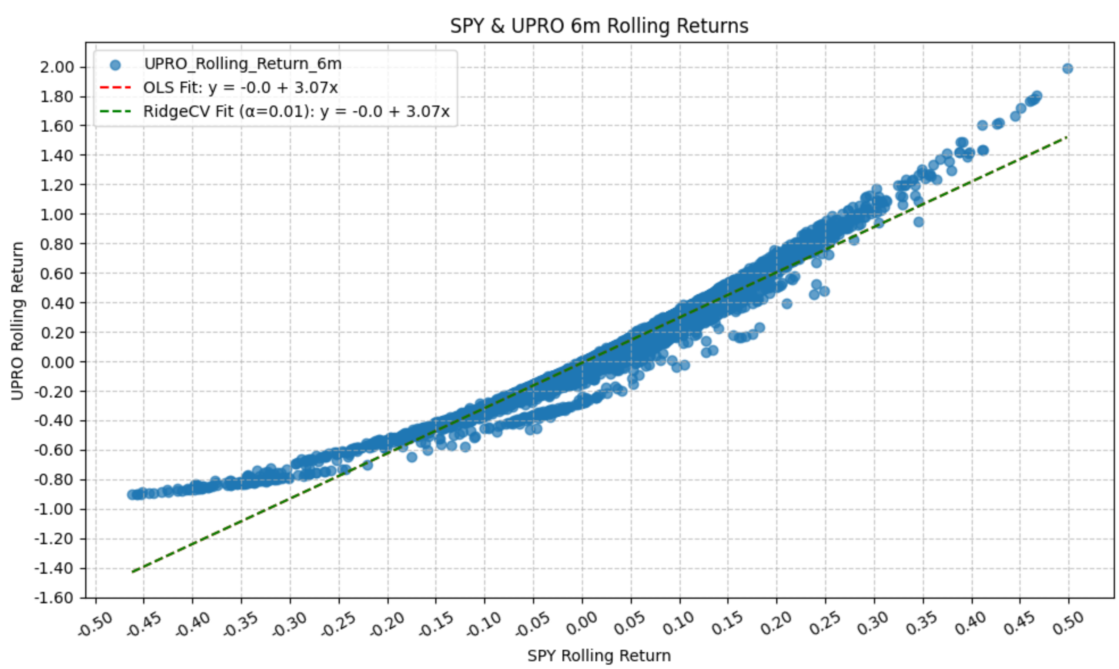





```
                            OLS Regression Results
================================================================================
==
Dep. Variable:     UPRO_Rolling_Return_3m   R-squared:
```

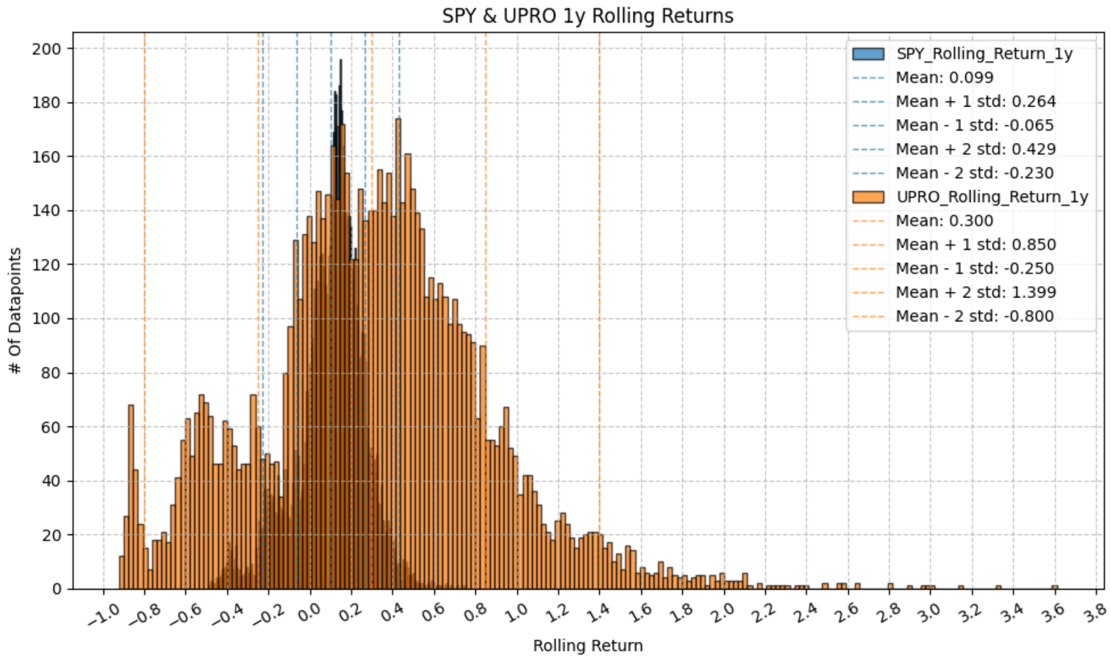
```
0.979
Model:                            OLS   Adj. R-squared:
0.979
Method:                 Least Squares   F-statistic:
3.832e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:27:59   Log-Likelihood:
16419.
No. Observations:                8274   AIC:
-3.283e+04
Df Residuals:                    8272   BIC:
-3.282e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
=========
                          coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                  -0.0068      0.000    -17.721      0.000      -0.008
-0.006
SPY_Rolling_Return_3m   3.0481      0.005    619.009      0.000       3.038
3.058
==============================================================================
Omnibus:                     2412.574   Durbin-Watson:                   0.136
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           132831.172
Skew:                           0.582   Prob(JB):                         0.00
Kurtosis:                      22.594   Cond. No.                         13.5
==============================================================================

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

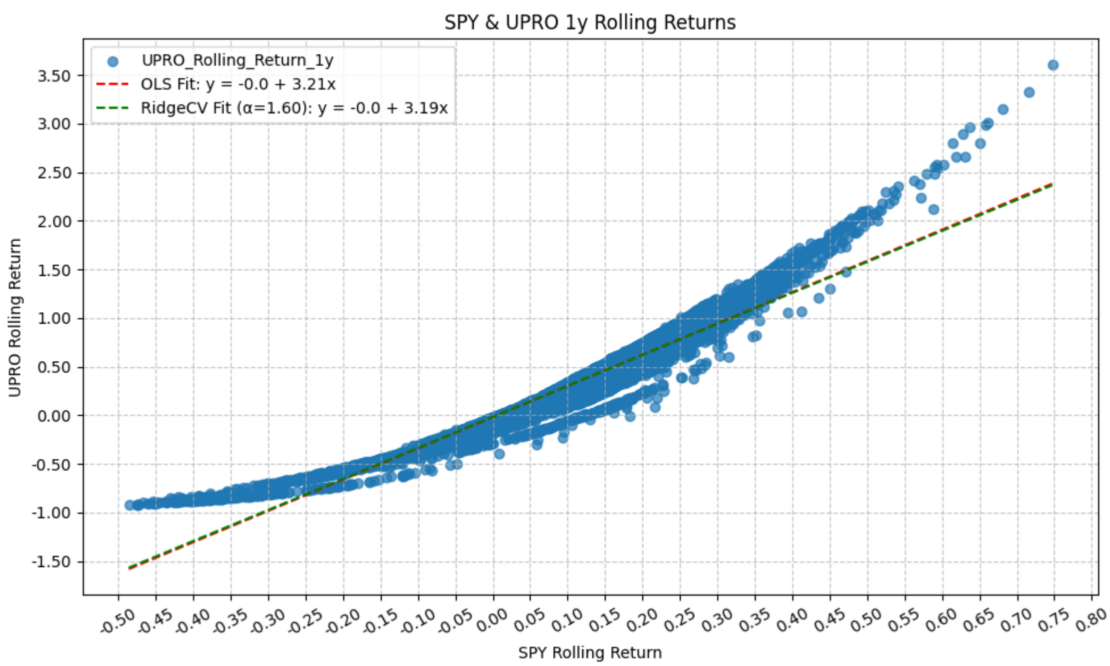





```
                            OLS Regression Results
==============================================================================
==
Dep. Variable:      UPRO_Rolling_Return_6m   R-squared:
```

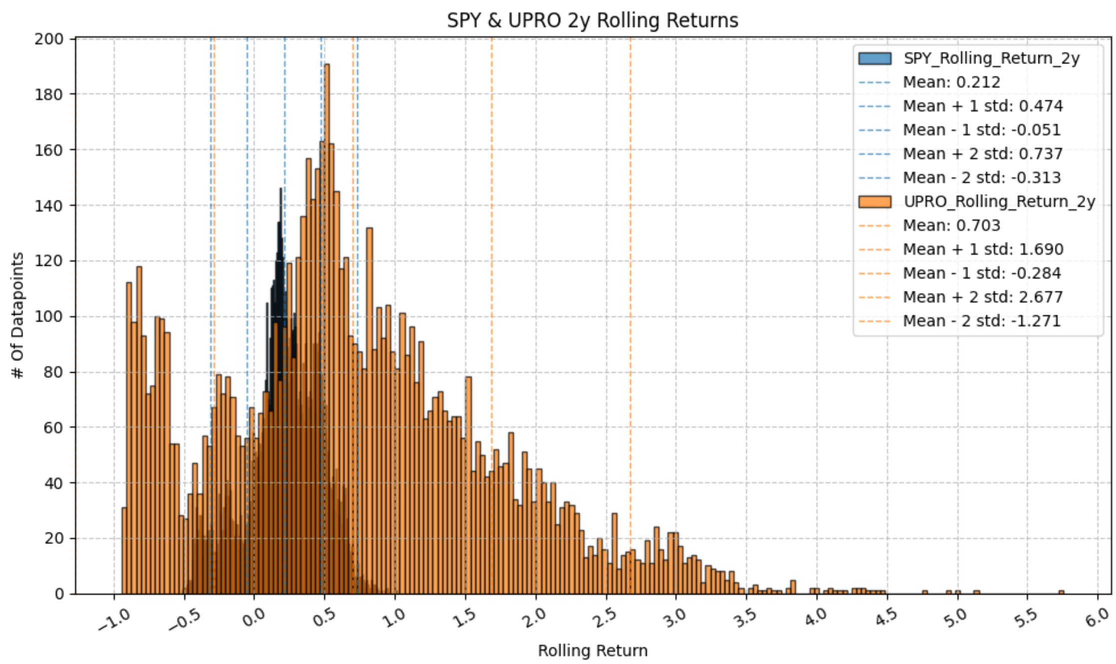
```
0.957
Model:                            OLS   Adj. R-squared:
0.957
Method:                 Least Squares   F-statistic:
1.830e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:28:00   Log-Likelihood:
10161.
No. Observations:                8211   AIC:
-2.032e+04
Df Residuals:                    8209   BIC:
-2.030e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
=========
                          coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                  -0.0109      0.001    -12.883      0.000      -0.013
-0.009
SPY_Rolling_Return_6m   3.0707      0.007    427.780      0.000       3.057
3.085
==============================================================================
Omnibus:                     2066.367   Durbin-Watson:                   0.055
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            26461.991
Skew:                           0.843   Prob(JB):                         0.00
Kurtosis:                      11.631   Cond. No.                         9.29
==============================================================================

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

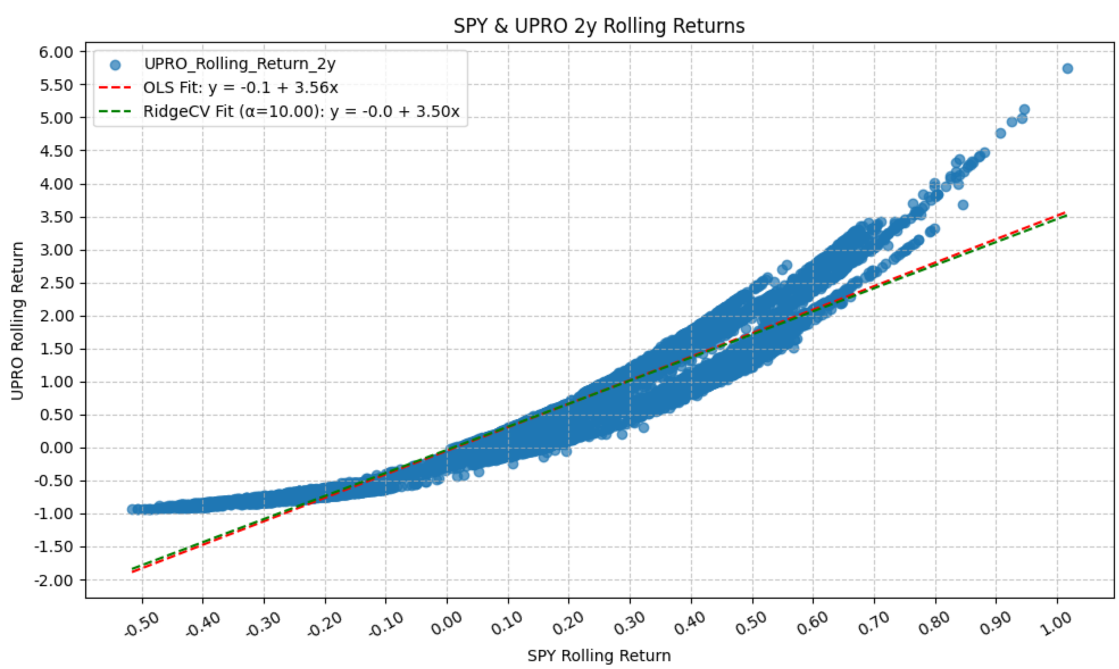





```
                       OLS Regression Results
================================================================================
==
Dep. Variable:     UPRO_Rolling_Return_1y   R-squared:
```

```
0.927
Model:                            OLS   Adj. R-squared:
0.927
Method:                 Least Squares   F-statistic:
1.024e+05
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:28:01   Log-Likelihood:
3932.3
No. Observations:                8085   AIC:
-7861.
Df Residuals:                    8083   BIC:
-7847.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
=========
                          coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                  -0.0196      0.002    -10.120      0.000      -0.023
-0.016
SPY_Rolling_Return_1y   3.2120      0.010    319.930      0.000       3.192
3.232
==============================================================================
Omnibus:                 1394.260   Durbin-Watson:                   0.031
Prob(Omnibus):              0.000   Jarque-Bera (JB):             6548.397
Skew:                       0.764   Prob(JB):                         0.00
Kurtosis:                   7.136   Cond. No.                         6.13
==============================================================================

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

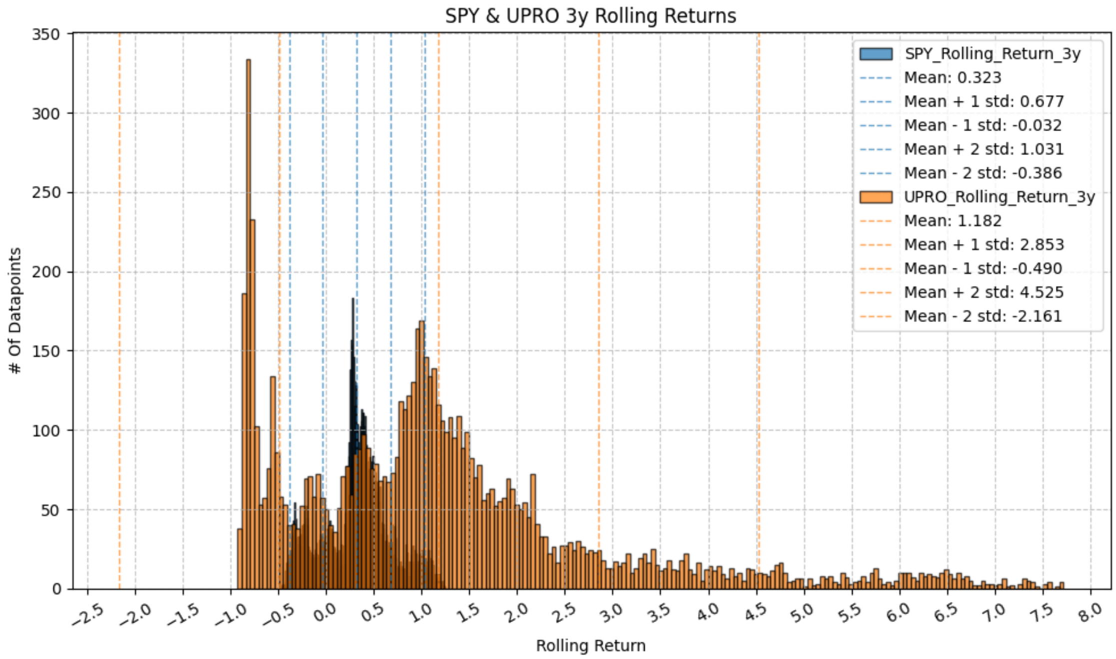


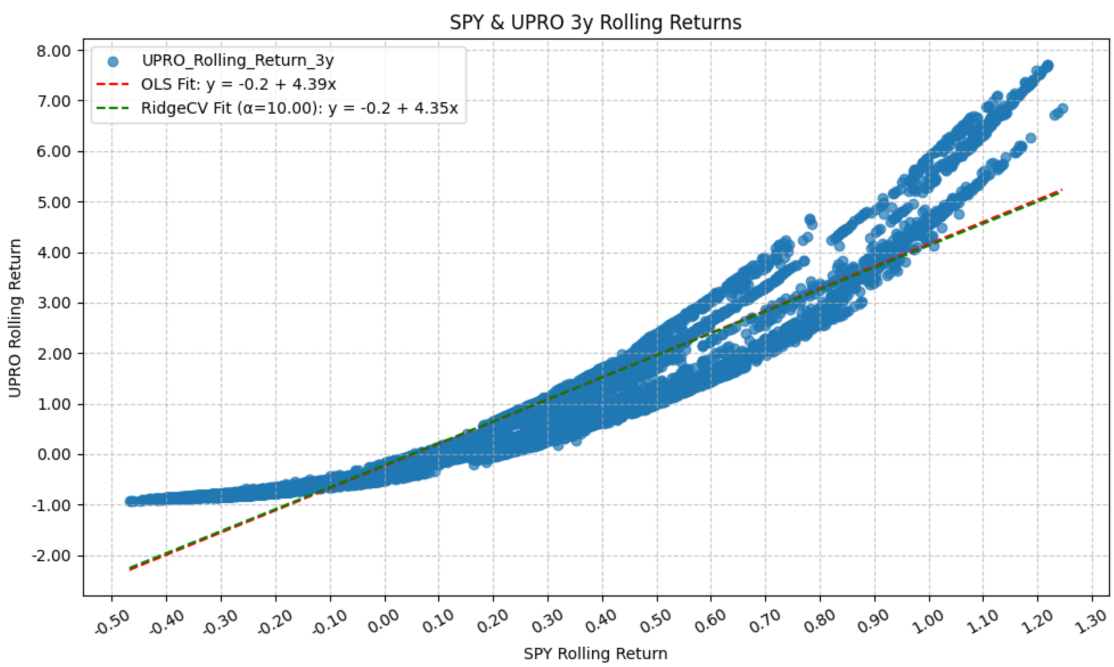


OLS Regression Results

```
================================================================================
==
Dep. Variable:     UPRO_Rolling_Return_2y   R-squared:
```

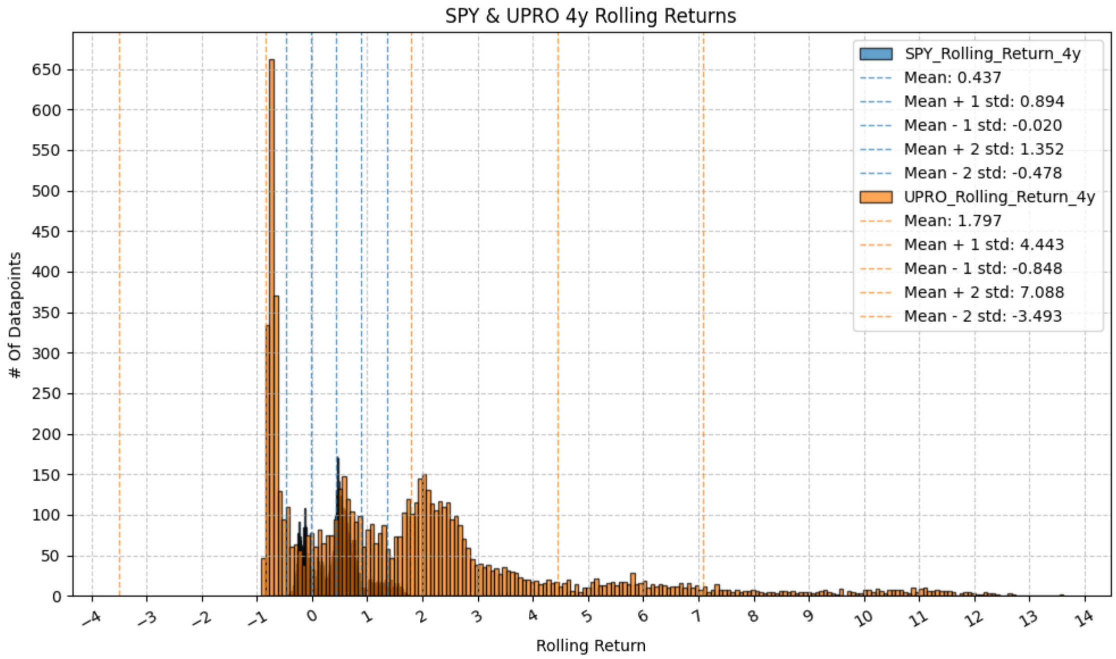
```
0.897
Model:                            OLS   Adj. R-squared:
0.897
Method:                 Least Squares   F-statistic:
6.796e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:28:02   Log-Likelihood:
-2121.4
No. Observations:                7833   AIC:
4247.
Df Residuals:                    7831   BIC:
4261.
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
=========
                          coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                  -0.0512      0.005    -11.120      0.000      -0.060
-0.042
SPY_Rolling_Return_2y    3.5614      0.014    260.683      0.000       3.535
3.588
==============================================================================
Omnibus:                      950.225   Durbin-Watson:                   0.018
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1486.222
Skew:                           0.866   Prob(JB):                         0.00
Kurtosis:                       4.246   Cond. No.                         3.99
==============================================================================

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

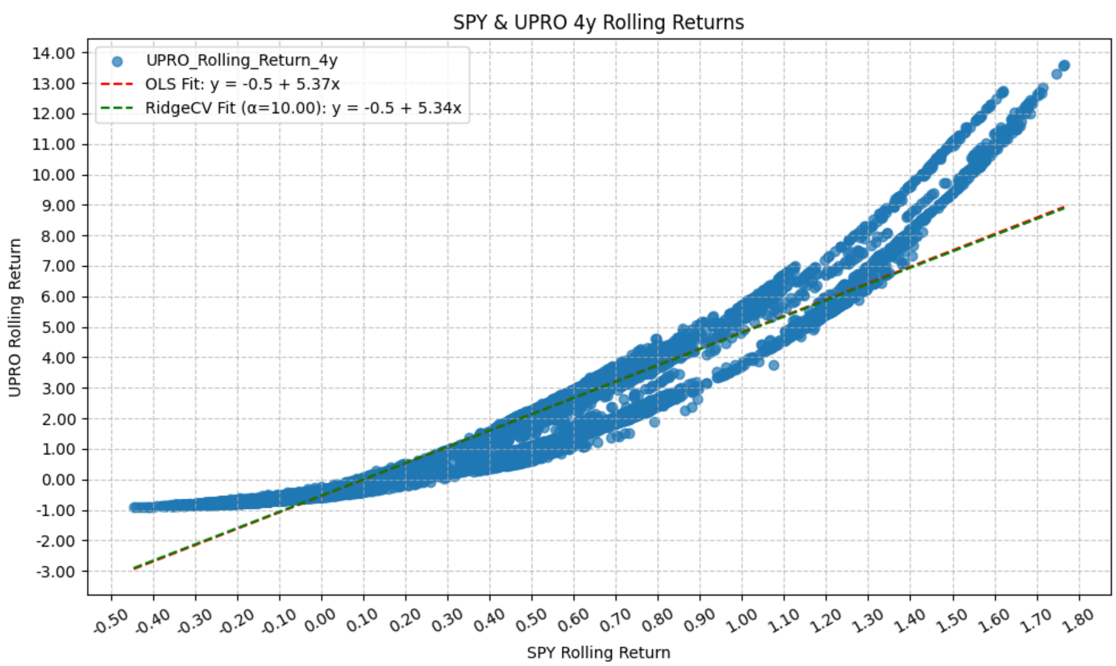





```
                              OLS Regression Results
==============================================================================
==
Dep. Variable:     UPRO_Rolling_Return_3y   R-squared:
```

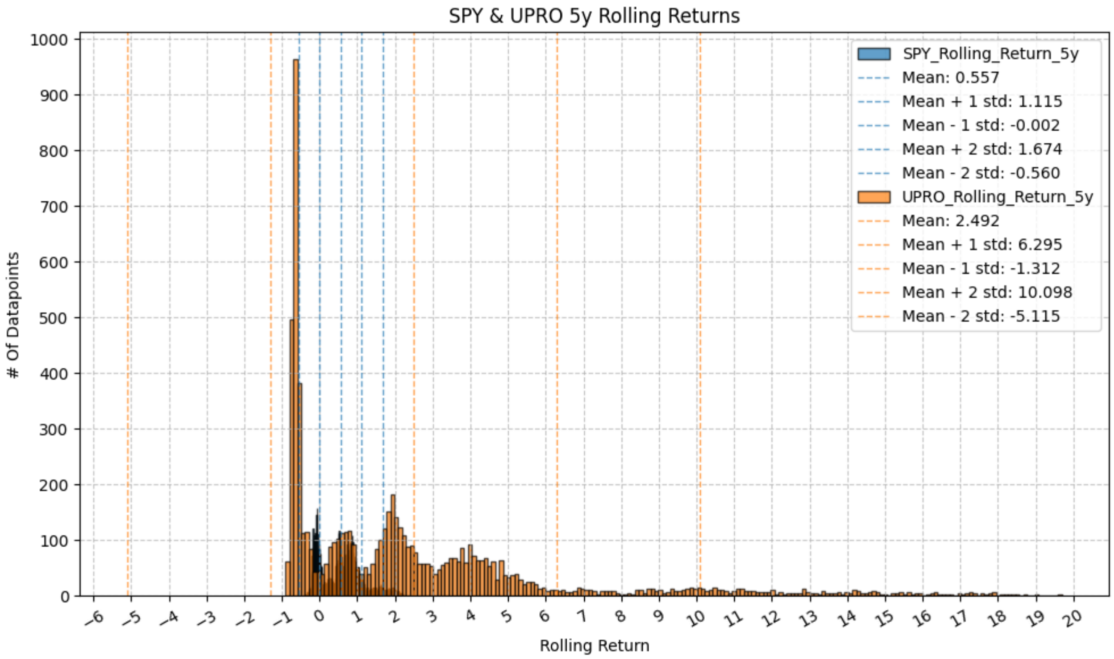
```
0.867
Model:                            OLS   Adj. R-squared:
0.867
Method:                 Least Squares   F-statistic:
4.922e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:28:04   Log-Likelihood:
-7016.3
No. Observations:                7581   AIC:
1.404e+04
Df Residuals:                    7579   BIC:
1.405e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
=========
                          coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                  -0.2356      0.009    -24.832      0.000      -0.254
-0.217
SPY_Rolling_Return_3y   4.3927      0.020    221.847      0.000       4.354
4.432
==============================================================================
Omnibus:                     1286.625   Durbin-Watson:                   0.008
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             2437.416
Skew:                           1.053   Prob(JB):                         0.00
Kurtosis:                       4.812   Cond. No.                         3.15
==============================================================================

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

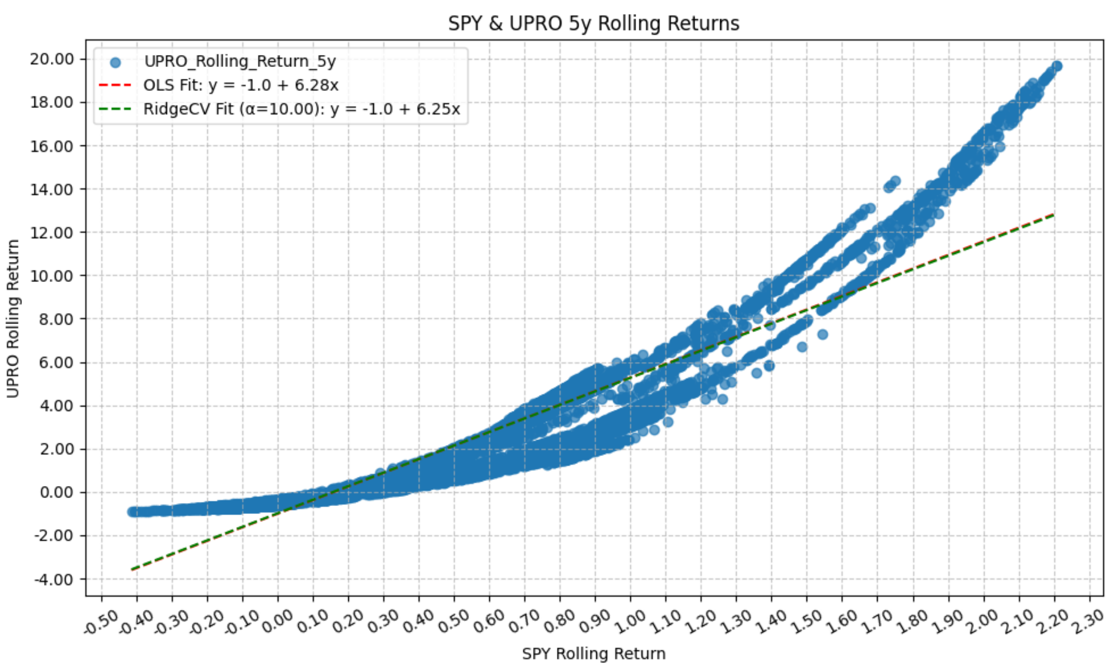





```
                              OLS Regression Results
===============================================================================
==
Dep. Variable:      UPRO_Rolling_Return_4y   R-squared:
```

```
0.863
Model:                            OLS   Adj. R-squared:
0.863
Method:                 Least Squares   F-statistic:
4.605e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:28:05   Log-Likelihood:
-10251.
No. Observations:                7329   AIC:
2.051e+04
Df Residuals:                    7327   BIC:
2.052e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
=========
                          coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                  -0.5499      0.016    -34.731      0.000      -0.581
-0.519
SPY_Rolling_Return_4y   5.3711      0.025    214.593      0.000       5.322
5.420
==============================================================================
Omnibus:                 1107.340   Durbin-Watson:                   0.008
Prob(Omnibus):              0.000   Jarque-Bera (JB):             2298.081
Skew:                       0.913   Prob(JB):                         0.00
Kurtosis:                   5.048   Cond. No.                         2.69
==============================================================================

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






```
                          OLS Regression Results
================================================================================
==
Dep. Variable:     UPRO_Rolling_Return_5y   R-squared:
```

```
0.850
Model:                            OLS   Adj. R-squared:
0.850
Method:                 Least Squares   F-statistic:
4.018e+04
Date:                Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                        14:28:06   Log-Likelihood:
-12776.
No. Observations:                7077   AIC:
2.556e+04
Df Residuals:                    7075   BIC:
2.557e+04
Df Model:                           1
Covariance Type:            nonrobust
================================================================================
=========
                          coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------------
---------
const                  -1.0034      0.025    -40.626      0.000      -1.052
-0.955
SPY_Rolling_Return_5y   6.2796      0.031    200.453      0.000       6.218
6.341
==============================================================================
Omnibus:                      685.964   Durbin-Watson:                   0.007
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1311.055
Skew:                           0.650   Prob(JB):                    2.03e-285
Kurtosis:                       4.660   Cond. No.                         2.50
==============================================================================

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

0.5.7 Rolling Returns Deviation (SPY & UPRO)

Next, we will the rolling returns deviation from the expected 3x return for each time period. This will give us a better picture of the volatility decay effect and how it changes over different time horizons.

[64]:
```
rolling_returns_stats["Return_Deviation_From_3x"] =
    rolling_returns_stats["Slope"] - 3.0
```

[65]:
```
display(rolling_returns_stats)
```

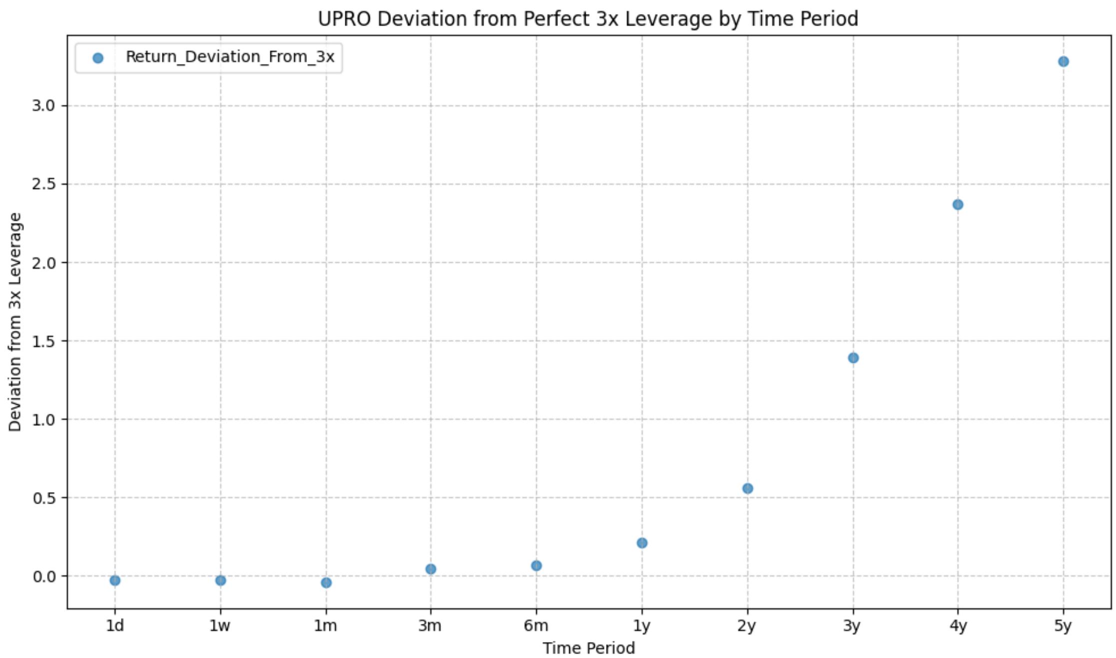
```
  Period  Intercept  Slope  R_Squared    Skew  Average Upside Beta  \
0     1d      0.000  2.976      0.997     NaN                2.939
```

```
0     1w     -0.000  2.972      0.994     NaN                2.757
0     1m     -0.002  2.960      0.988     NaN                2.494
0     3m     -0.007  3.048      0.979     NaN                2.006
0     6m     -0.011  3.071      0.957     NaN                1.038
0     1y     -0.020  3.212      0.927     NaN                1.640
0     2y     -0.051  3.561      0.897   0.349                1.862
0     3y     -0.236  4.393      0.867  -6.067                1.578
0     4y     -0.550  5.371      0.863 -65.924                0.021
0     5y     -1.003  6.280      0.850 -35.218               -2.261

   Average Downside Beta  Asymmetry  Return_Deviation_From_3x
0                    NaN        NaN                    -0.024
0                    NaN        NaN                    -0.028
0                   -inf        inf                    -0.040
0                   -inf        inf                     0.048
0                   -inf        inf                     0.071
0                   -inf        inf                     0.212
0                  9.298     -7.436                     0.561
0                  8.621     -7.042                     1.393
0                  7.235     -7.214                     2.371
0                 21.003    -23.265                     3.280
```

[66]:

```
plot_scatter(
    df=rolling_returns_stats,
    x_plot_column="Period",
    y_plot_columns=["Return_Deviation_From_3x"],
    title="UPRO Deviation from Perfect 3x Leverage by Time Period",
    x_label="Time Period",
    x_format="String",
    x_format_decimal_places=0,
    x_tick_spacing=1,
    x_tick_rotation=0,
    y_label="Deviation from 3x Leverage",
    y_format="Decimal",
    y_format_decimal_places=1,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=False,
    OLS_column=None,
    plot_Ridge_regression_line=False,
    Ridge_column=None,
    plot_RidgeCV_regression_line=False,
    RidgeCV_column=None,
    regression_constant=False,
    grid=True,
    legend=True,
    export_plot=False,
```

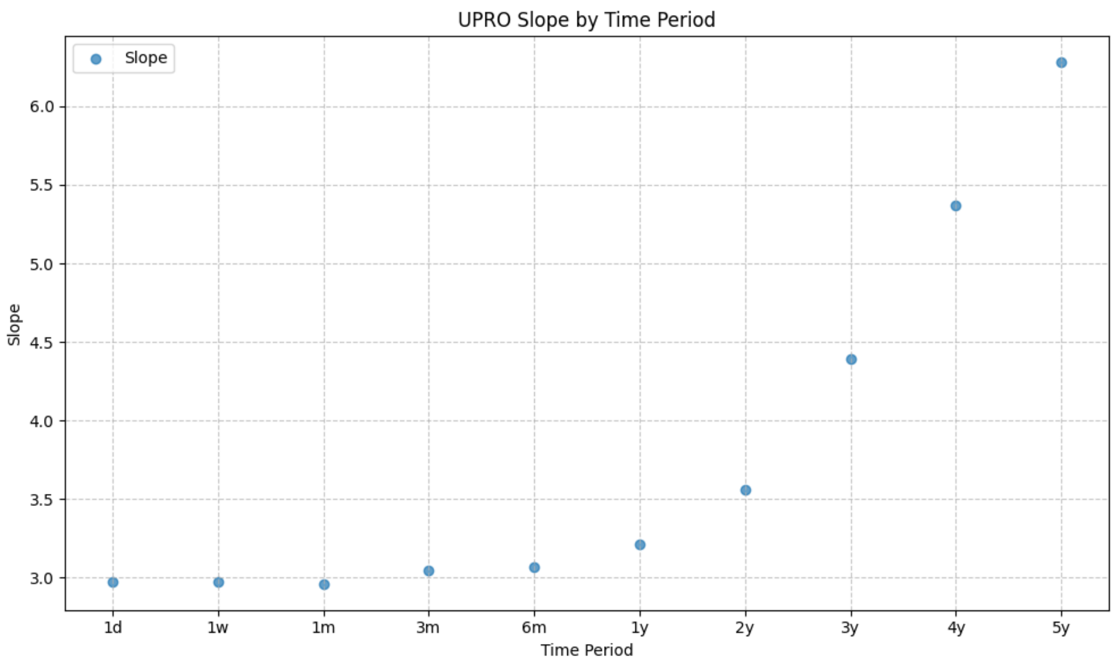
```
    plot_file_name=None,
)
```



[67]:

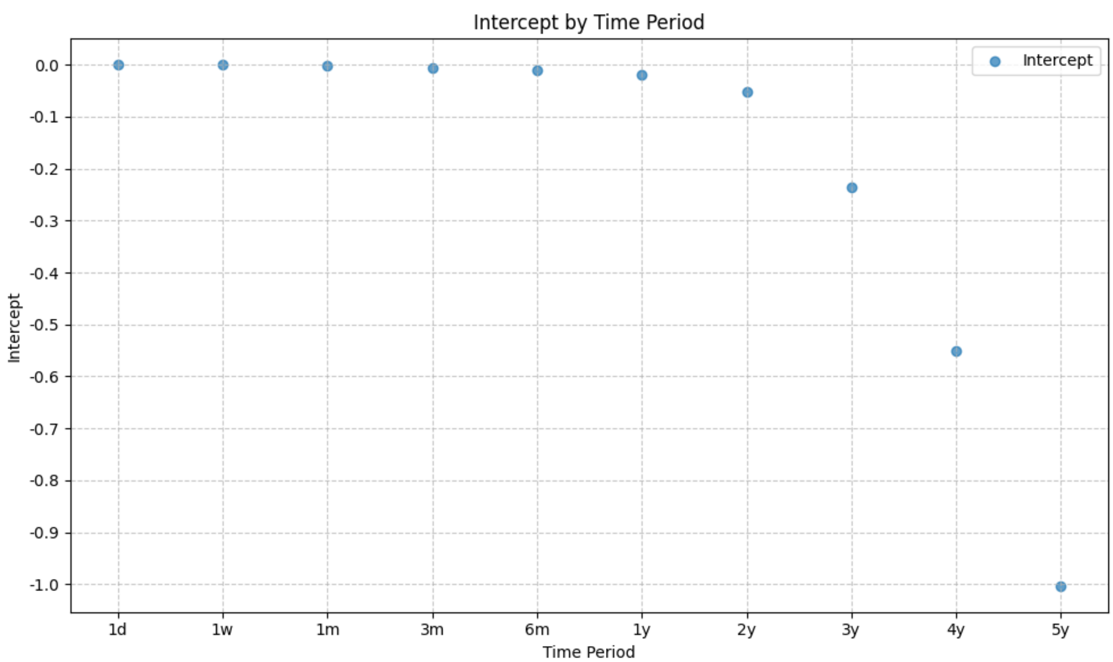
```
plot_scatter(
    df=rolling_returns_stats,
    x_plot_column="Period",
    y_plot_columns=["Slope"],
    title="UPRO Slope by Time Period",
    x_label="Time Period",
    x_format="String",
    x_format_decimal_places=0,
    x_tick_spacing=1,
    x_tick_rotation=0,
    y_label="Slope",
    y_format="Decimal",
    y_format_decimal_places=1,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=False,
    OLS_column=None,
    plot_Ridge_regression_line=False,
    Ridge_column=None,
    plot_RidgeCV_regression_line=False,
    RidgeCV_column=None,
    regression_constant=False,
```

```
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



[68]:
```
plot_scatter(
    df=rolling_returns_stats,
    x_plot_column="Period",
    y_plot_columns=["Intercept"],
    title="Intercept by Time Period",
    x_label="Time Period",
    x_format="String",
    x_format_decimal_places=0,
    x_tick_spacing=1,
    x_tick_rotation=0,
    y_label="Intercept",
    y_format="Decimal",
    y_format_decimal_places=1,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=False,
    OLS_column=None,
    plot_Ridge_regression_line=False,
    Ridge_column=None,
```

```
    plot_RidgeCV_regression_line=False,
    RidgeCV_column=None,
    regression_constant=False,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



[69]:
```
pandas_set_decimal_places(3)
display(rolling_returns_stats.set_index("Period"))
```

```
        Intercept  Slope  R_Squared    Skew  Average Upside Beta  \
Period
1d          0.000  2.976      0.997     NaN                2.939
1w         -0.000  2.972      0.994     NaN                2.757
1m         -0.002  2.960      0.988     NaN                2.494
3m         -0.007  3.048      0.979     NaN                2.006
6m         -0.011  3.071      0.957     NaN                1.038
1y         -0.020  3.212      0.927     NaN                1.640
2y         -0.051  3.561      0.897   0.349                1.862
3y         -0.236  4.393      0.867  -6.067                1.578
4y         -0.550  5.371      0.863 -65.924                0.021
5y         -1.003  6.280      0.850 -35.218               -2.261

        Average Downside Beta  Asymmetry  Return_Deviation_From_3x
```

```
Period
1d                    NaN       NaN                  -0.024
1w                    NaN       NaN                  -0.028
1m                   -inf       inf                  -0.040
3m                   -inf       inf                   0.048
6m                   -inf       inf                   0.071
1y                   -inf       inf                   0.212
2y                  9.298    -7.436                   0.561
3y                  8.621    -7.042                   1.393
4y                  7.235    -7.214                   2.371
5y                 21.003   -23.265                   3.280
```

Similar as to QQQ/TQQQ, up to 1 year, there is minimal difference between the mean UPRO 1 year rolling return and the hypothetical 3x leverage, with an R^2 of greater than 0.9.

However, as we extend the time period, we see that

- The "leverage factor" increases significantly, resulting in a deviation from the perfect 3x leverage.
- The intercept also begins to deviate significantly from 0.

0.5.8 Rolling Returns Following Drawdowns (SPY & UPRO)

We will identify the drawdown levels of UPRO and then look at the subsequent rolling returns over various time horizons.

[70]:
```
# Copy DataFrame
spy_upro_extrap_future = spy_upro_extrap.copy()

# Create a list of drawdown levels to analyze
drawdown_levels = [-0.10, -0.20, -0.30, -0.40, -0.50, -0.60, -0.70, -0.80]

# Shift the rolling return columns by the number of days in the rolling window␣
↪to get the returns following the drawdown
for etf in etfs:
    for period_name, window in rolling_windows.items():
        spy_upro_extrap_future[f"{etf}_Rolling_Future_Return_{period_name}"] =␣
↪spy_upro_extrap_future[f"{etf}_Rolling_Return_{period_name}"].shift(-window)
```

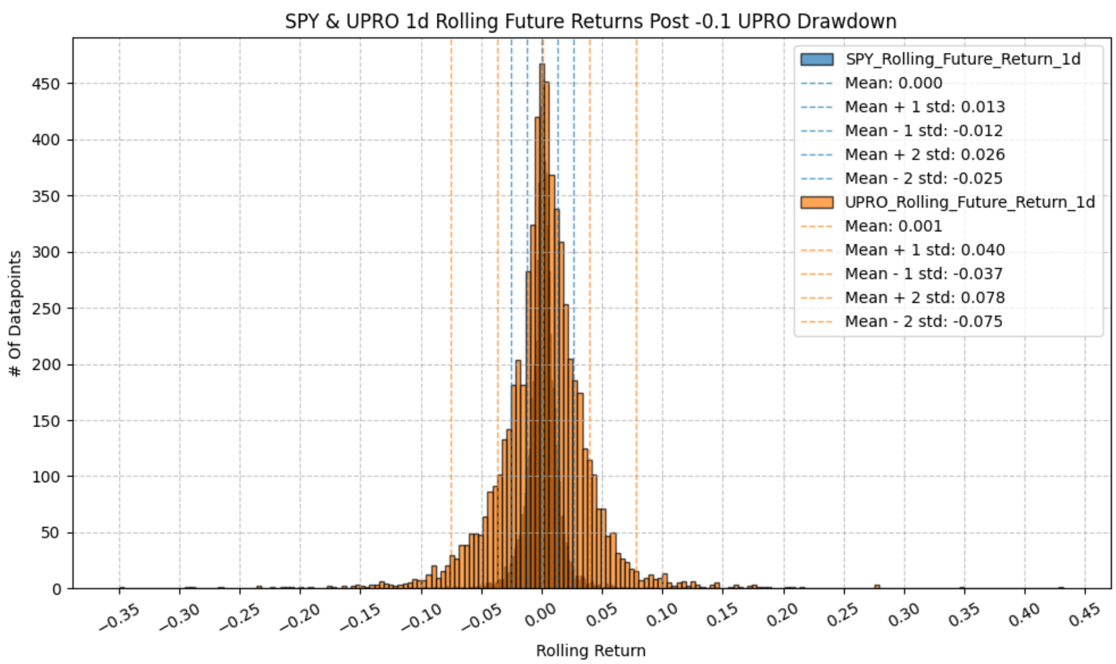
Now, we can analyze the future rolling returns following specific drawdown levels:

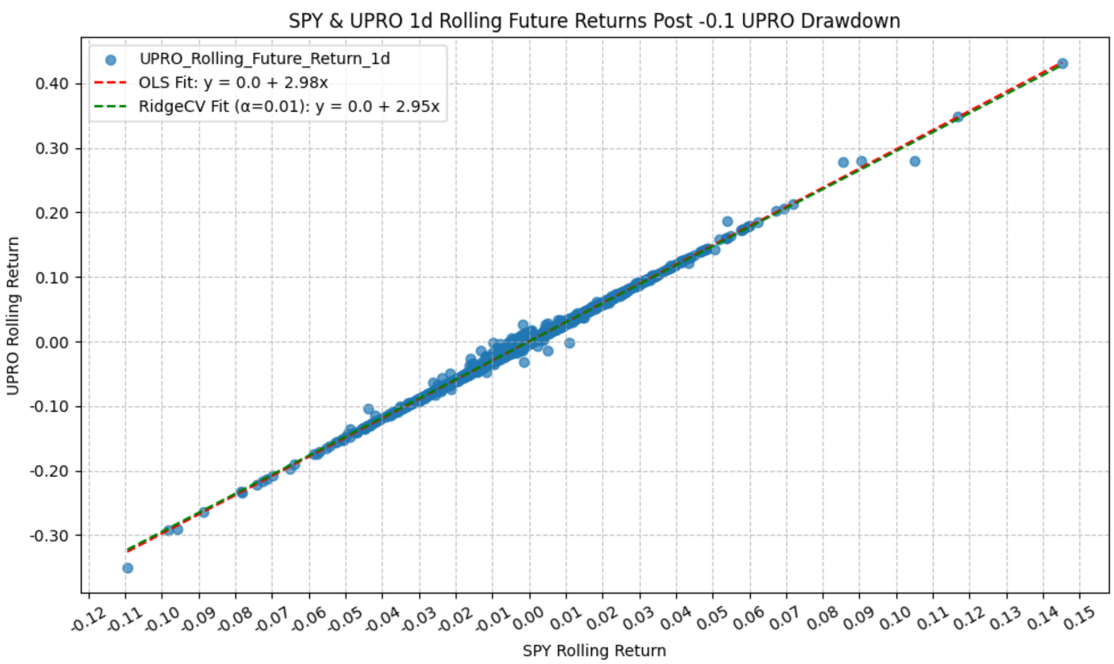
[71]:
```
# Create a dataframe to hold rolling returns stats
rolling_returns_drawdown_stats = pd.DataFrame()

for drawdown in drawdown_levels:

    for period_name, window in rolling_windows.items():

        try:
            plot_histogram(
```

```
␣
↪df=spy_upro_extrap_future[spy_upro_extrap_future["UPRO_Drawdown"] <=␣
↪drawdown],
              plot_columns=[f"SPY_Rolling_Future_Return_{period_name}",␣
↪f"UPRO_Rolling_Future_Return_{period_name}"],
              title=f"SPY & UPRO {period_name} Rolling Future Returns Post␣
↪{drawdown} UPRO Drawdown",
              x_label="Rolling Return",
              x_tick_spacing="Auto",
              x_tick_rotation=30,
              y_label="# Of Datapoints",
              y_tick_spacing="Auto",
              y_tick_rotation=0,
              grid=True,
              legend=True,
              export_plot=False,
              plot_file_name=None,
          )

          plot_scatter(
␣
↪df=spy_upro_extrap_future[spy_upro_extrap_future["UPRO_Drawdown"] <=␣
↪drawdown],
              x_plot_column=f"SPY_Rolling_Future_Return_{period_name}",
              y_plot_columns=[f"UPRO_Rolling_Future_Return_{period_name}"],
              title=f"SPY & UPRO {period_name} Rolling Future Returns Post␣
↪{drawdown} UPRO Drawdown",
              x_label="SPY Rolling Return",
              x_format="Decimal",
              x_format_decimal_places=2,
              x_tick_spacing="Auto",
              x_tick_rotation=30,
              y_label="UPRO Rolling Return",
              y_format="Decimal",
              y_format_decimal_places=2,
              y_tick_spacing="Auto",
              y_tick_rotation=0,
              plot_OLS_regression_line=True,
              OLS_column=f"UPRO_Rolling_Future_Return_{period_name}",
              plot_Ridge_regression_line=False,
              Ridge_column=None,
              plot_RidgeCV_regression_line=True,
              RidgeCV_column=f"UPRO_Rolling_Future_Return_{period_name}",
              regression_constant=True,
              grid=True,
              legend=True,
              export_plot=False,
```

```
            plot_file_name=None,
        )

        # Run OLS regression with statsmodels
        model = run_linear_regression(
            ␣
↪df=spy_upro_extrap_future[spy_upro_extrap_future["UPRO_Drawdown"] <=␣
↪drawdown],
            x_plot_column=f"SPY_Rolling_Future_Return_{period_name}",
            y_plot_column=f"UPRO_Rolling_Future_Return_{period_name}",
            regression_model="OLS-statsmodels",
            regression_constant=True,
        )
        print(model.summary())

        # Filter by drawdown
        drawdown_filter =␣
↪spy_upro_extrap_future[spy_upro_extrap_future["UPRO_Drawdown"] <= drawdown]

        # Filter by period, drop rows with missing values
        future_filter =␣
↪drawdown_filter[[f"UPRO_Rolling_Future_Return_{period_name}"]].dropna()

        # Find length of future dataframe
        future_length = len(future_filter)

        # Find length of future dataframe where return is positive
        positive_future_length =␣
↪len(future_filter[future_filter[f"UPRO_Rolling_Future_Return_{period_name}"]␣
↪> 0])

        # Calculate percentage of future returns that are positive
        positive_future_percentage = (positive_future_length /␣
↪future_length) if future_length > 0 else 0

        # Add the regression results to the rolling returns stats dataframe
        intercept = model.params[0]
        # intercept_pvalue = model.pvalues[0]   # p-value for Intercept
        slope = model.params[1]
        # slope_pvalue = model.pvalues[1]       # p-value for Slope
        r_squared = model.rsquared

        rolling_returns_slope_int = pd.DataFrame({
            "Drawdown": drawdown,
            "Period": period_name,
            "Intercept": [intercept],
            # "Intercept_PValue": [intercept_pvalue],
```

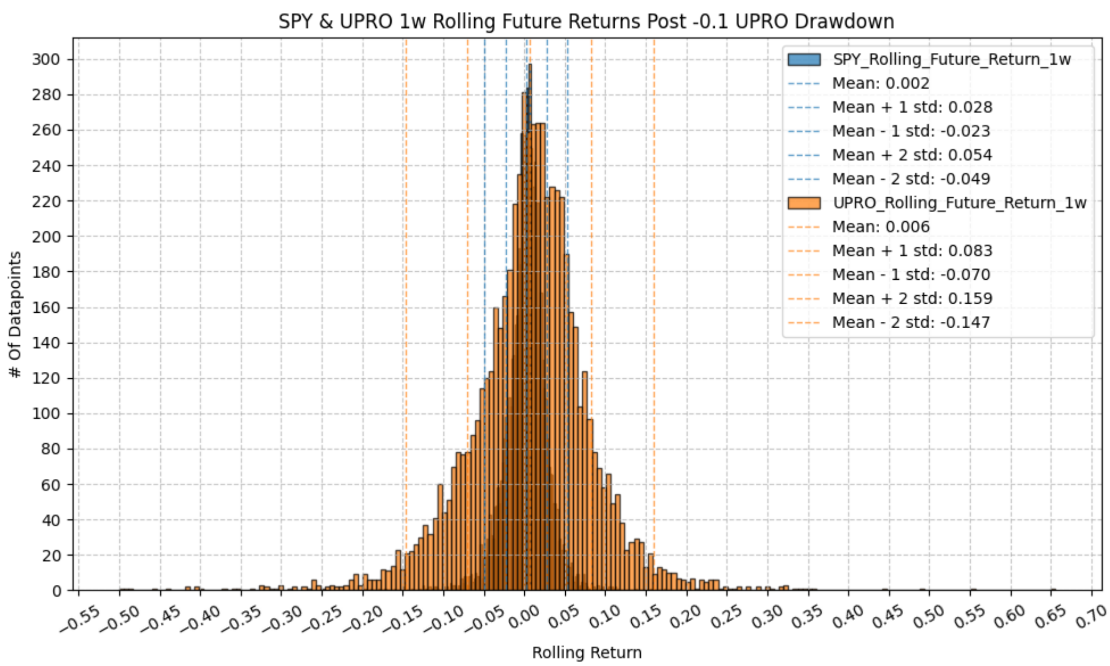
```
                "Slope": [slope],
                # "Slope_PValue": [slope_pvalue],
                "R_Squared": [r_squared],
                "Positive_Future_Percentage": [positive_future_percentage],
            })

            rolling_returns_drawdown_stats = pd.
↪concat([rolling_returns_drawdown_stats, rolling_returns_slope_int])

        except:
            print(f"Not enough data points for drawdown level {drawdown} and␣
↪period {period_name} to run regression.")
```

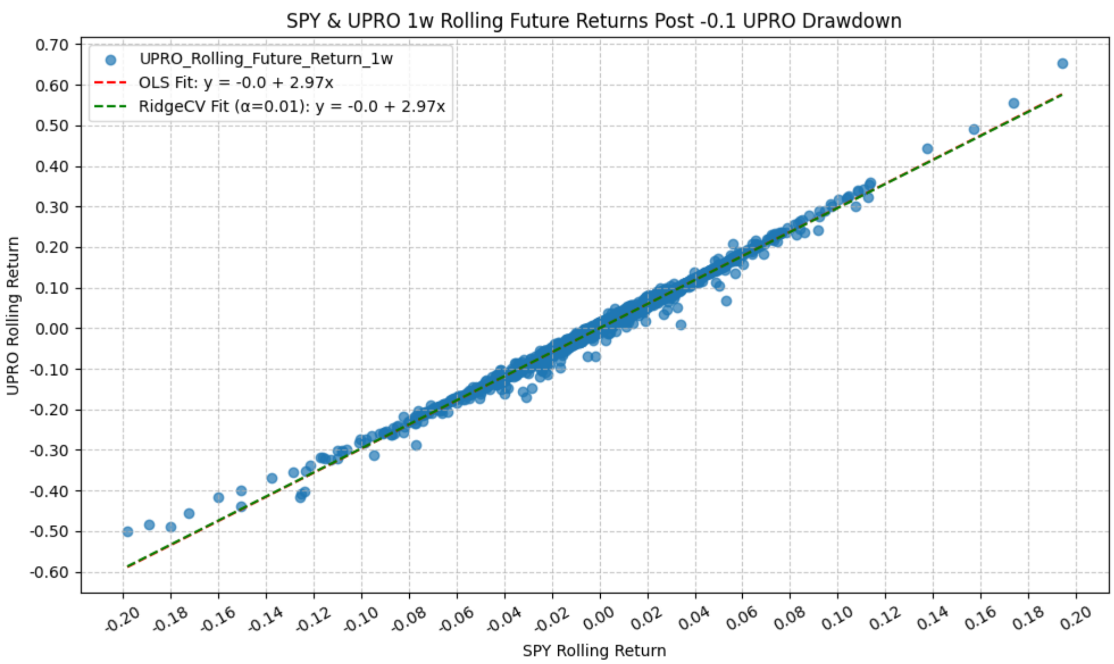





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1d   R-squared:
0.997
Model:                                       OLS   Adj. R-squared:
0.997
Method:                            Least Squares   F-statistic:
2.285e+06
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:07   Log-Likelihood:
29859.
No. Observations:                           6221   AIC:
-5.971e+04
Df Residuals:                               6219   BIC:
-5.970e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                         2.196e-05   2.53e-05      0.869      0.385
```

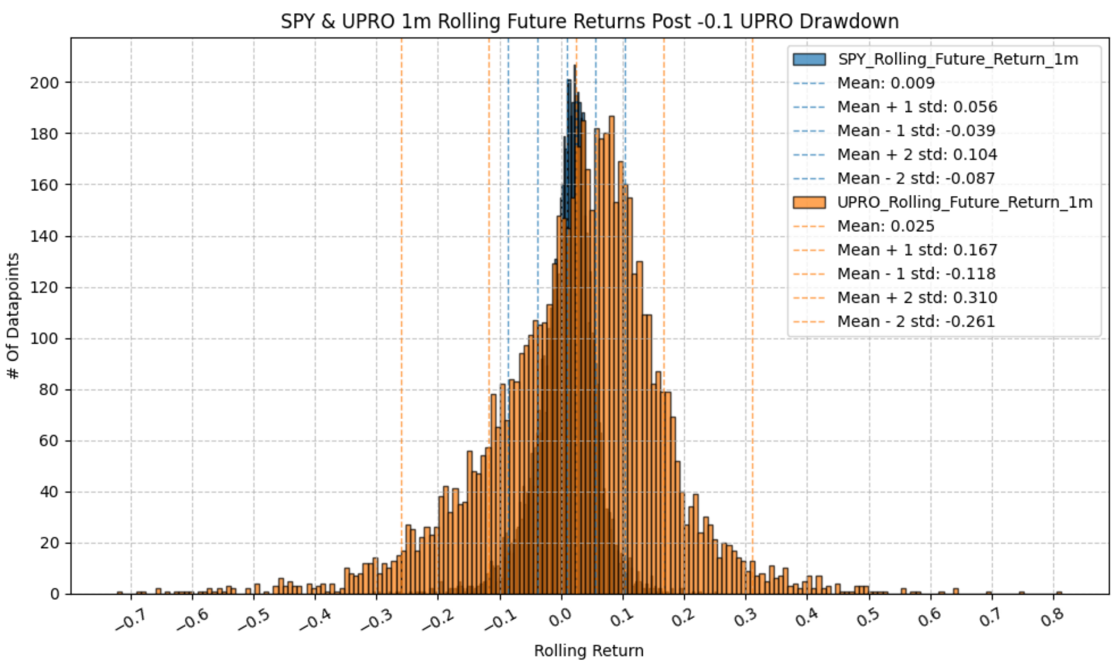
```
-2.76e-05    7.15e-05
SPY_Rolling_Future_Return_1d     2.9765      0.002    1511.654      0.000
2.973       2.980
==============================================================================
Omnibus:                     4600.809   Durbin-Watson:                   2.630
Prob(Omnibus):                  0.000   Jarque-Bera (JB):          2414888.124
Skew:                           2.321   Prob(JB):                         0.00
Kurtosis:                      99.410   Cond. No.                         78.0
==============================================================================

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

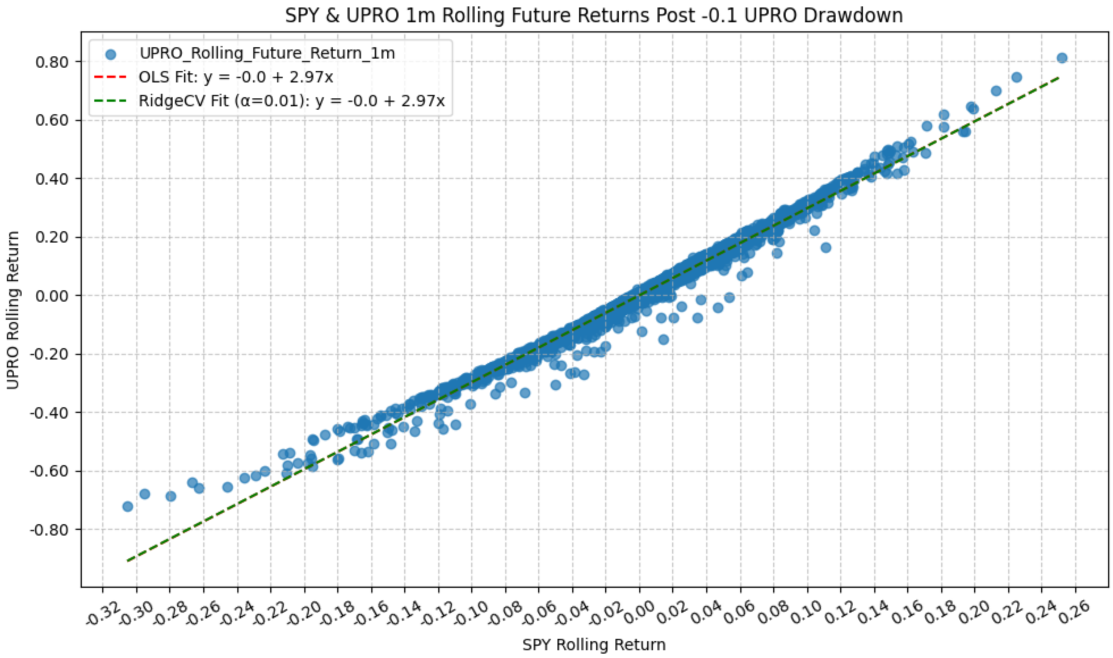





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1w   R-squared:
0.994
Model:                                       OLS   Adj. R-squared:
0.994
Method:                            Least Squares   F-statistic:
9.665e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:09   Log-Likelihood:
22872.
No. Observations:                           6219   AIC:
-4.574e+04
Df Residuals:                               6217   BIC:
-4.573e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.0002   7.79e-05     -3.047      0.002
```

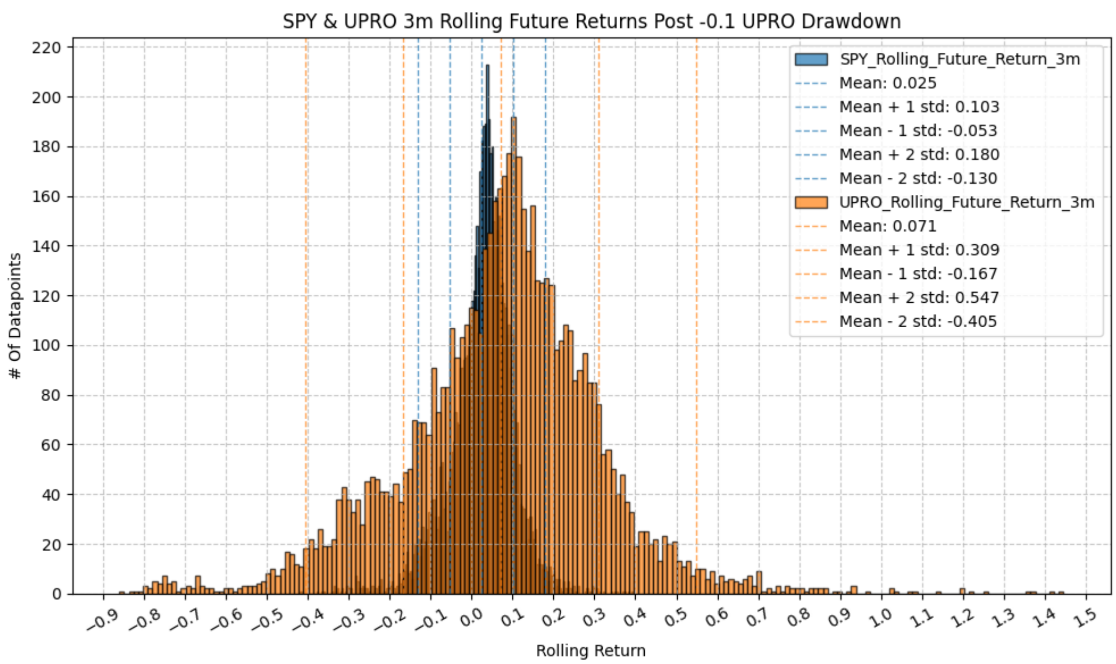
```
-0.000    -8.46e-05
SPY_Rolling_Future_Return_1w      2.9732       0.003     983.115       0.000
2.967       2.979
==============================================================================
Omnibus:                     2734.500   Durbin-Watson:                   0.978
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           782234.894
Skew:                          -0.876   Prob(JB):                         0.00
Kurtosis:                      57.915   Cond. No.                         39.0
==============================================================================

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

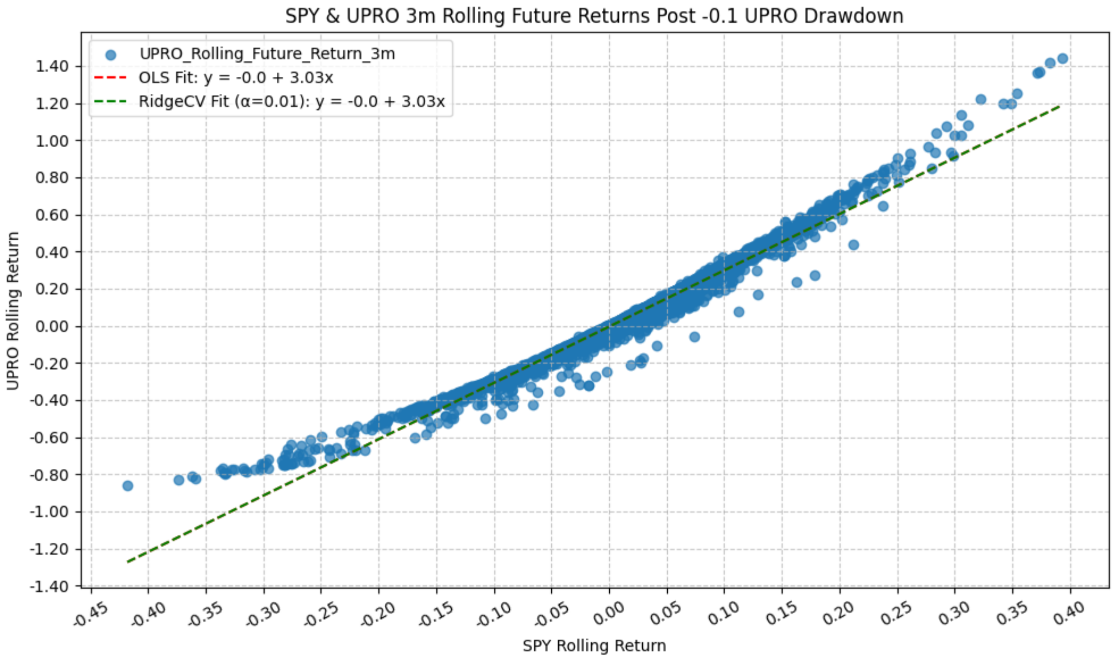





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1m   R-squared:
0.988
Model:                                       OLS   Adj. R-squared:
0.988
Method:                            Least Squares   F-statistic:
4.994e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:10   Log-Likelihood:
16962.
No. Observations:                           6218   AIC:
-3.392e+04
Df Residuals:                               6216   BIC:
-3.391e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.0015      0.000     -7.184      0.000
```

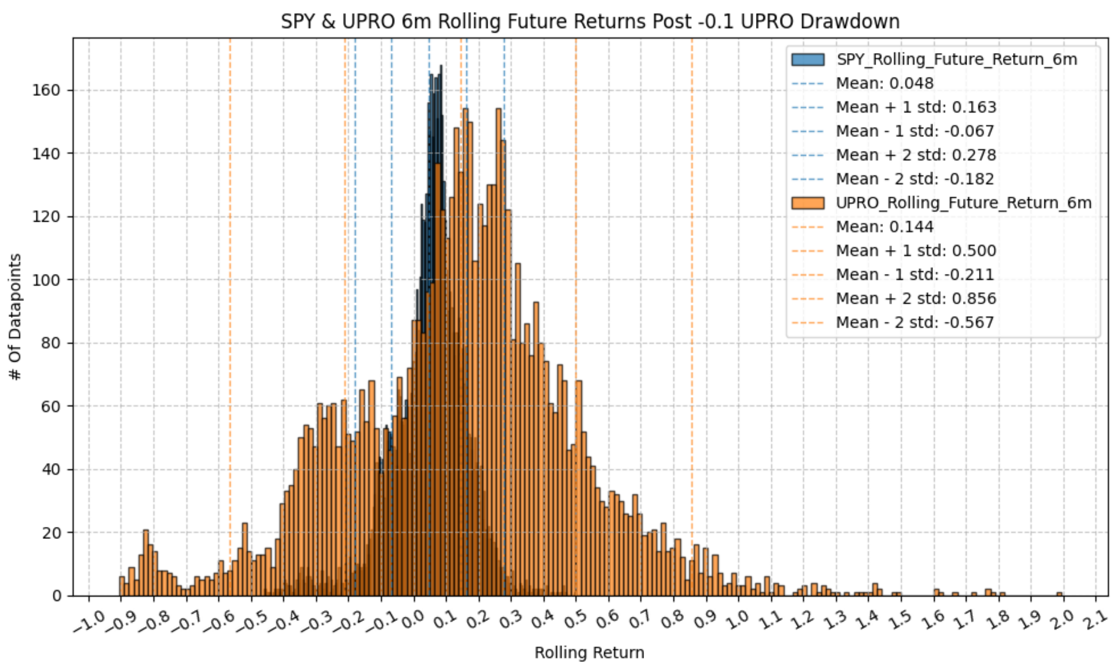
```
-0.002      -0.001
SPY_Rolling_Future_Return_1m     2.9746      0.004    706.661      0.000
2.966       2.983
==============================================================================
Omnibus:                     3371.444   Durbin-Watson:                   0.336
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           387348.606
Skew:                          -1.631   Prob(JB):                         0.00
Kurtosis:                      41.528   Cond. No.                         21.0
==============================================================================

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

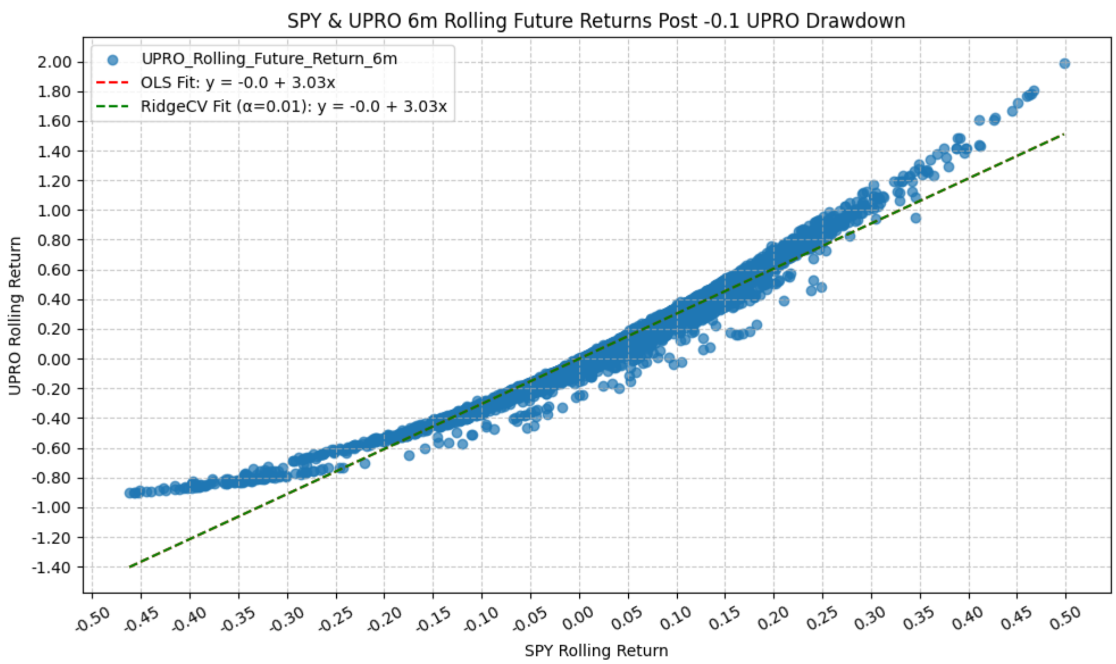





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:      UPRO_Rolling_Future_Return_3m   R-squared:
0.978
Model:                                        OLS   Adj. R-squared:
0.978
Method:                             Least Squares   F-statistic:
2.716e+05
Date:                            Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                    14:28:11   Log-Likelihood:
11917.
No. Observations:                            6218   AIC:
-2.383e+04
Df Residuals:                                6216   BIC:
-2.382e+04
Df Model:                                       1
Covariance Type:                        nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0048      0.000    -10.061      0.000
```

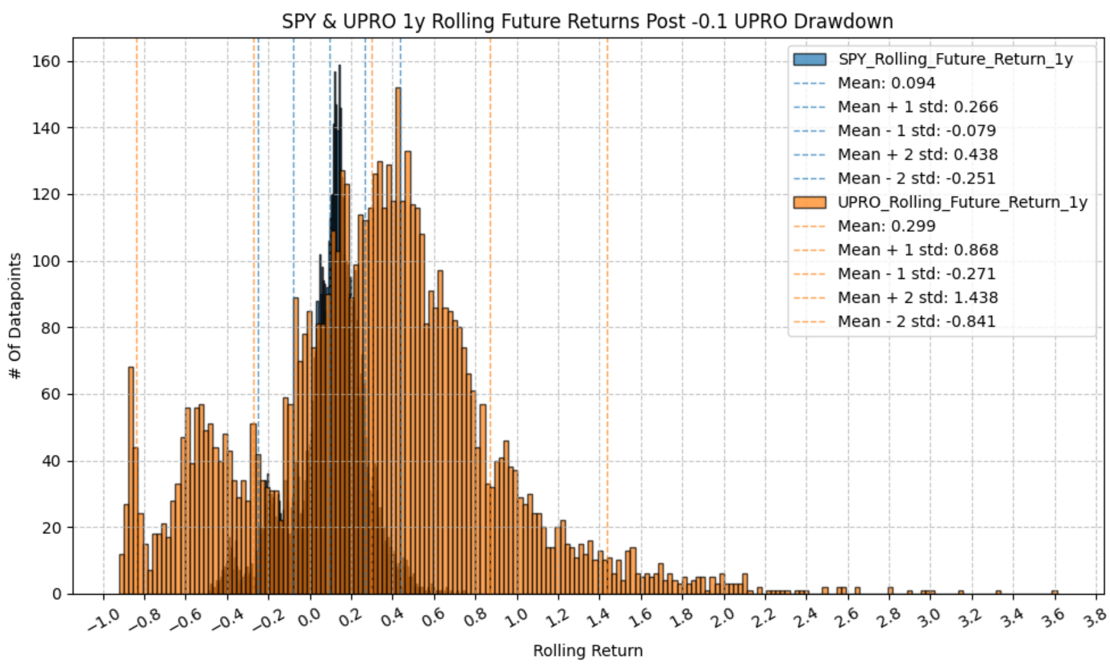
```
-0.006      -0.004
SPY_Rolling_Future_Return_3m     3.0334      0.006    521.161      0.000
3.022       3.045
==============================================================================
Omnibus:                     1724.576   Durbin-Watson:                   0.148
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            87846.616
Skew:                           0.522   Prob(JB):                         0.00
Kurtosis:                      21.384   Cond. No.                         12.9
==============================================================================

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

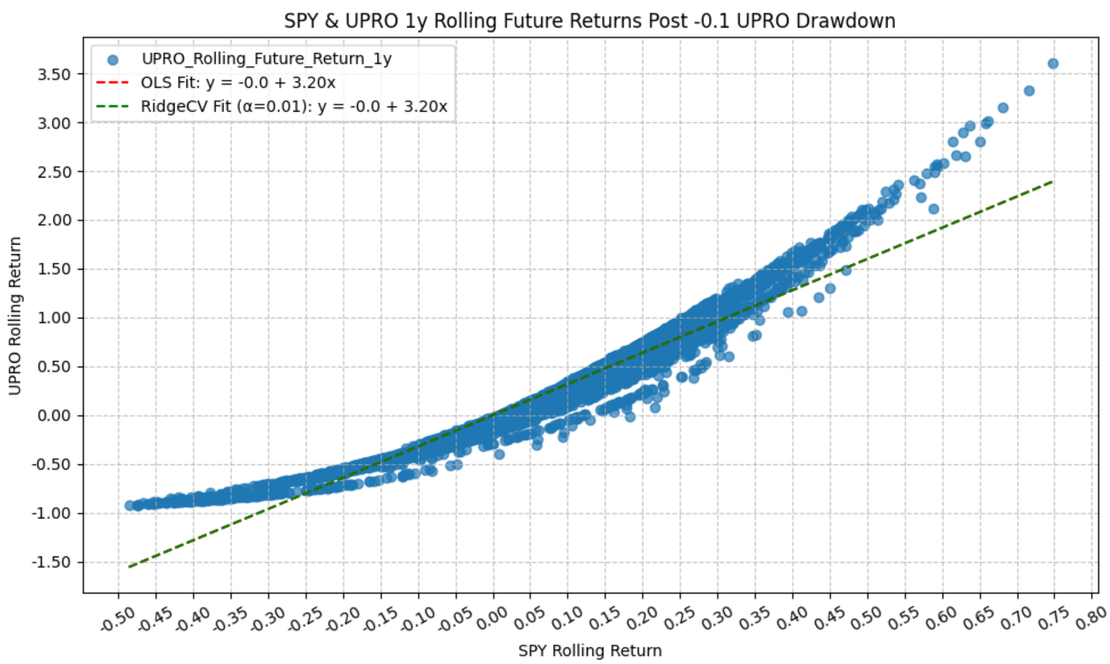





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_6m   R-squared:
0.961
Model:                                       OLS   Adj. R-squared:
0.961
Method:                            Least Squares   F-statistic:
1.537e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:12   Log-Likelihood:
7698.5
No. Observations:                           6214   AIC:
-1.539e+04
Df Residuals:                               6212   BIC:
-1.538e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                         -0.0015      0.001     -1.526      0.127
```

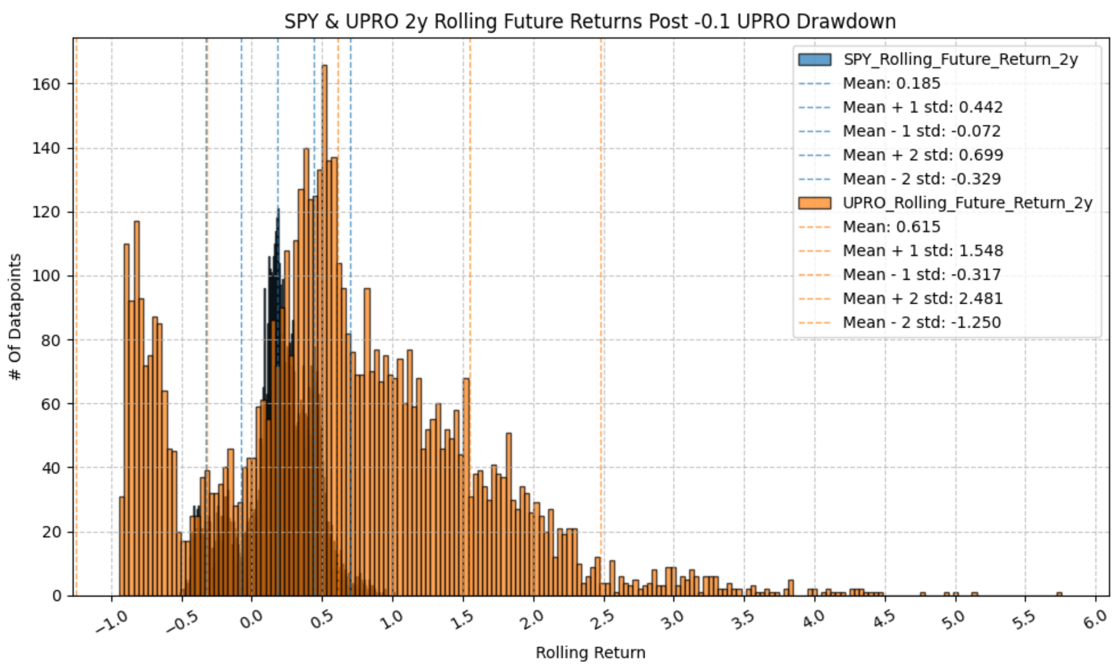
```
-0.003       0.000
SPY_Rolling_Future_Return_6m     3.0330       0.008     391.990       0.000
3.018       3.048
==============================================================================
Omnibus:                     2086.730   Durbin-Watson:                   0.070
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            20739.746
Skew:                           1.316   Prob(JB):                         0.00
Kurtosis:                      11.554   Cond. No.                         8.72
==============================================================================

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

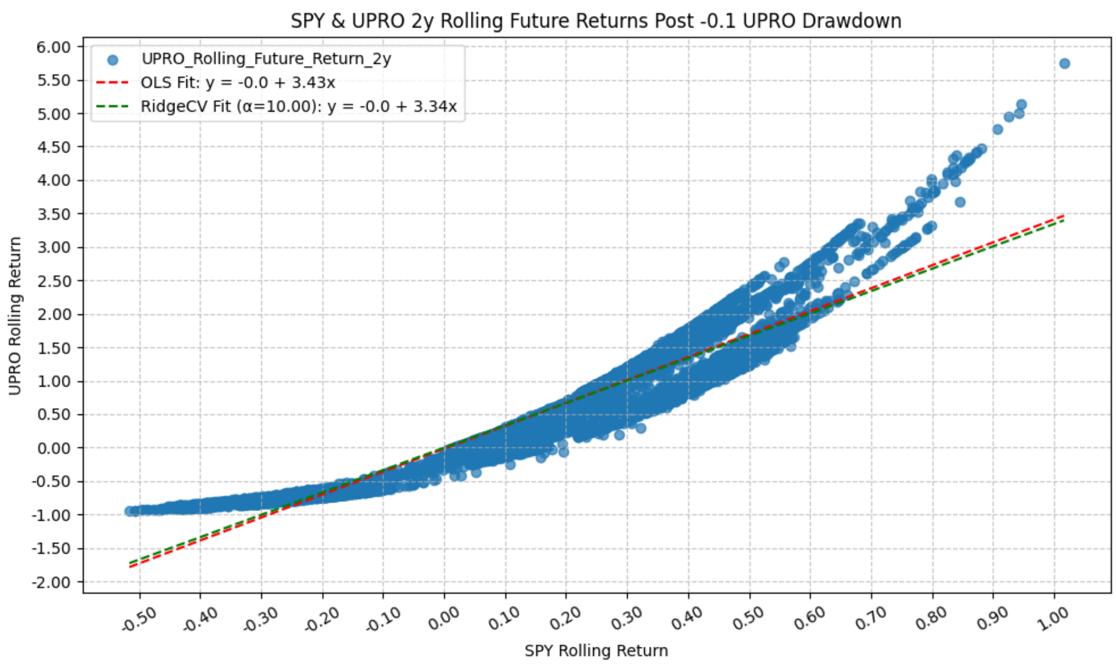





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1y   R-squared:
0.934
Model:                                       OLS   Adj. R-squared:
0.934
Method:                            Least Squares   F-statistic:
8.620e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:13   Log-Likelihood:
3064.8
No. Observations:                           6141   AIC:
-6126.
Df Residuals:                               6139   BIC:
-6112.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0007      0.002     -0.314      0.754
```

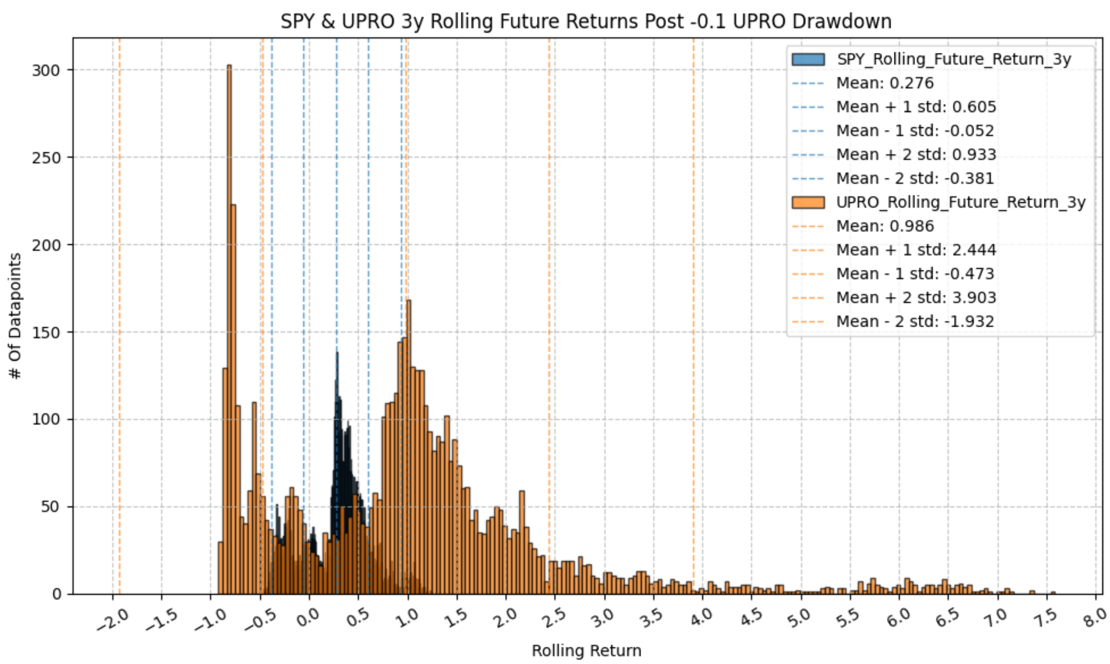
```
-0.005      0.004
SPY_Rolling_Future_Return_1y     3.1993      0.011    293.600      0.000
3.178       3.221
==============================================================================
Omnibus:                     1575.656   Durbin-Watson:                   0.041
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             7484.757
Skew:                           1.162   Prob(JB):                         0.00
Kurtosis:                       7.883   Cond. No.                         5.86
==============================================================================

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

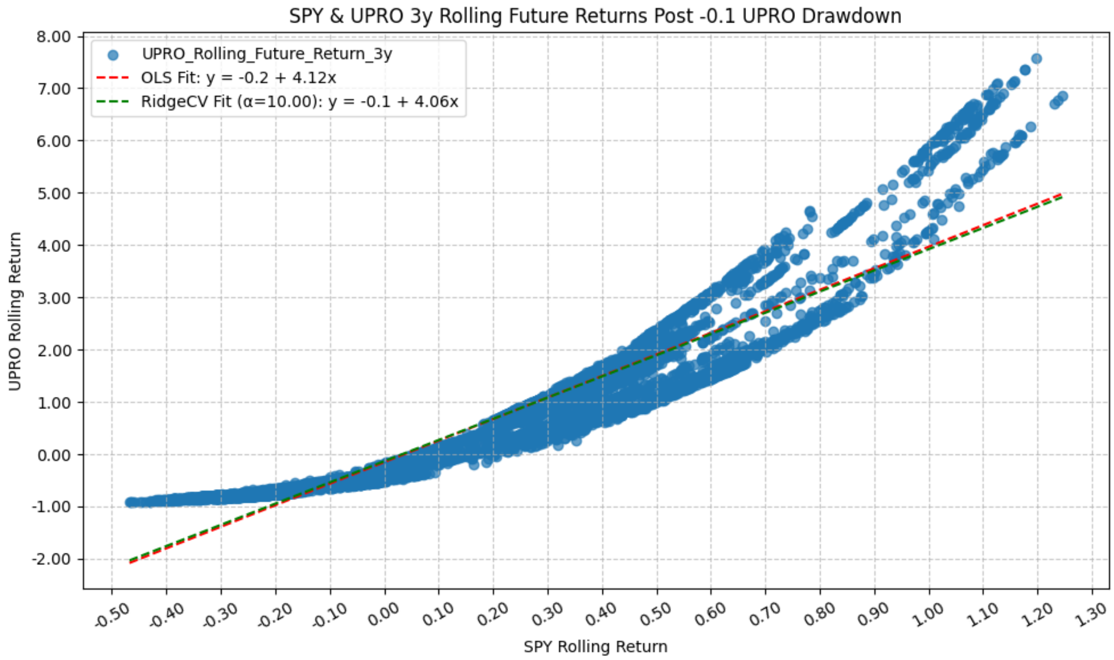





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_2y   R-squared:
0.892
Model:                                       OLS   Adj. R-squared:
0.892
Method:                            Least Squares   F-statistic:
4.980e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:14   Log-Likelihood:
-1446.2
No. Observations:                           6061   AIC:
2896.
Df Residuals:                               6059   BIC:
2910.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                               coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                       -0.0175      0.005     -3.607      0.000
```

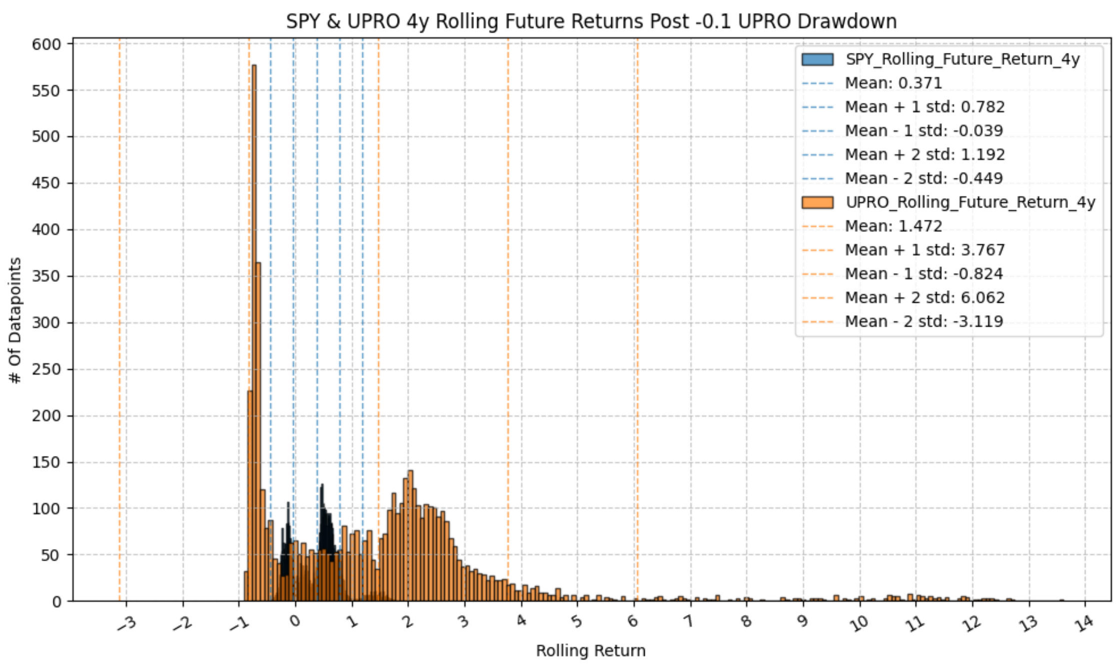
```
-0.027      -0.008
SPY_Rolling_Future_Return_2y     3.4272      0.015    223.154      0.000
3.397       3.457
==============================================================================
Omnibus:                     1154.327   Durbin-Watson:                   0.024
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             2673.564
Skew:                           1.077   Prob(JB):                         0.00
Kurtosis:                       5.438   Cond. No.                         4.03
==============================================================================

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

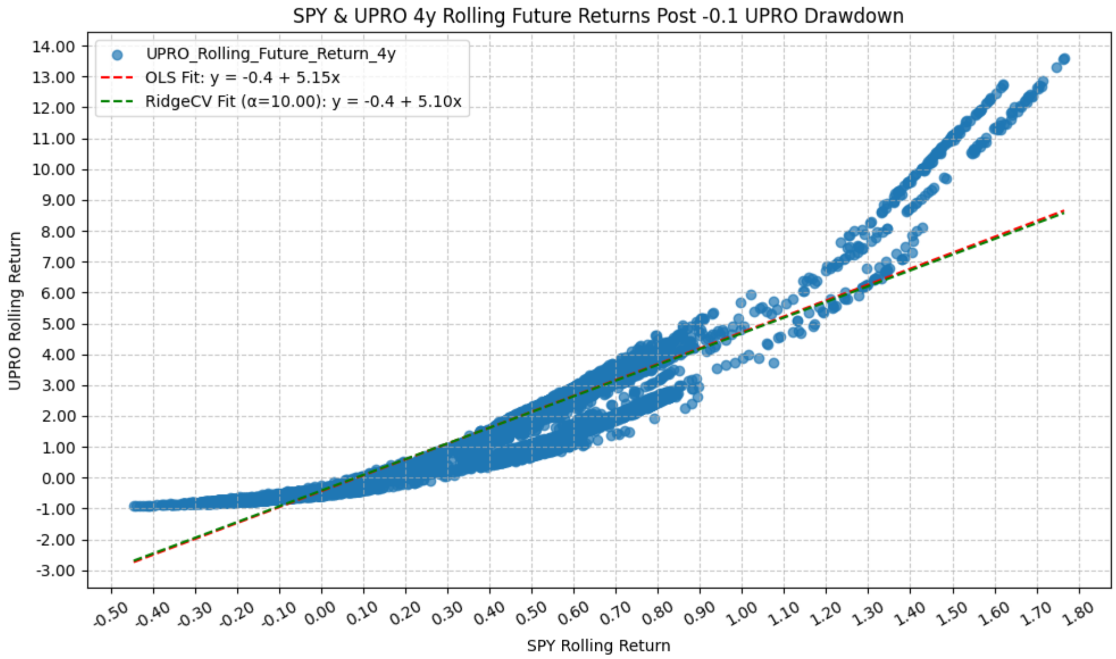





```
                                   OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3y   R-squared:
0.861
Model:                                       OLS   Adj. R-squared:
0.861
Method:                            Least Squares   F-statistic:
3.592e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:16   Log-Likelihood:
-4707.3
No. Observations:                           5809   AIC:
9419.
Df Residuals:                               5807   BIC:
9432.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.1527      0.009    -16.369      0.000
```

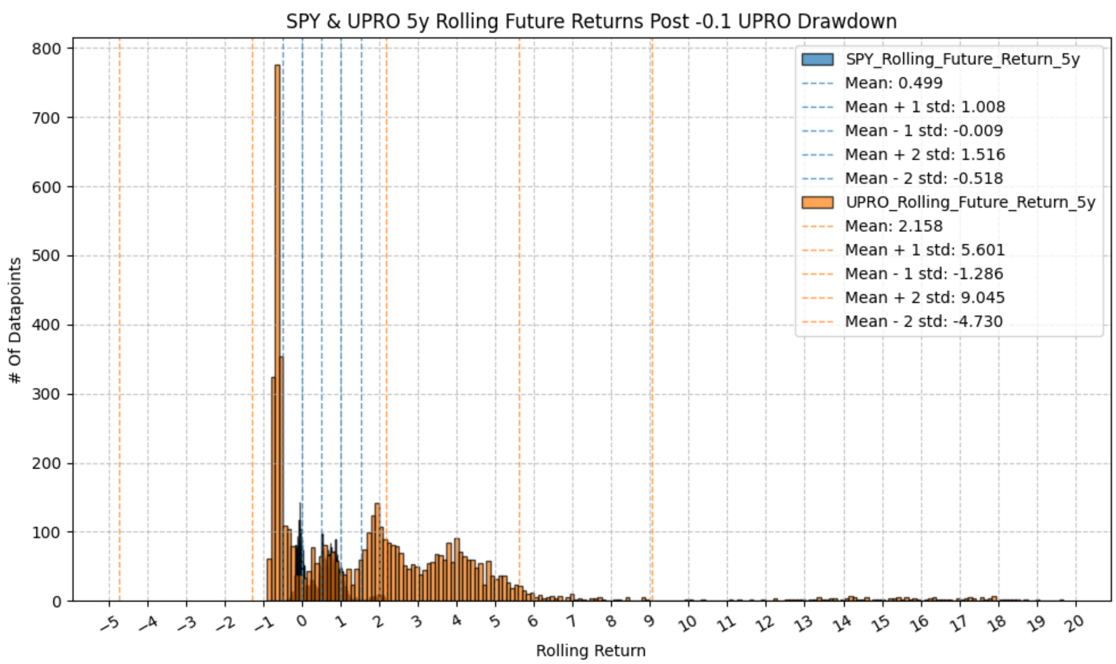
```
-0.171      -0.134
SPY_Rolling_Future_Return_3y     4.1206      0.022    189.528      0.000
4.078       4.163
==============================================================================
Omnibus:                     1530.432   Durbin-Watson:                   0.011
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4862.520
Skew:                           1.335   Prob(JB):                         0.00
Kurtosis:                       6.601   Cond. No.                         3.30
==============================================================================

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

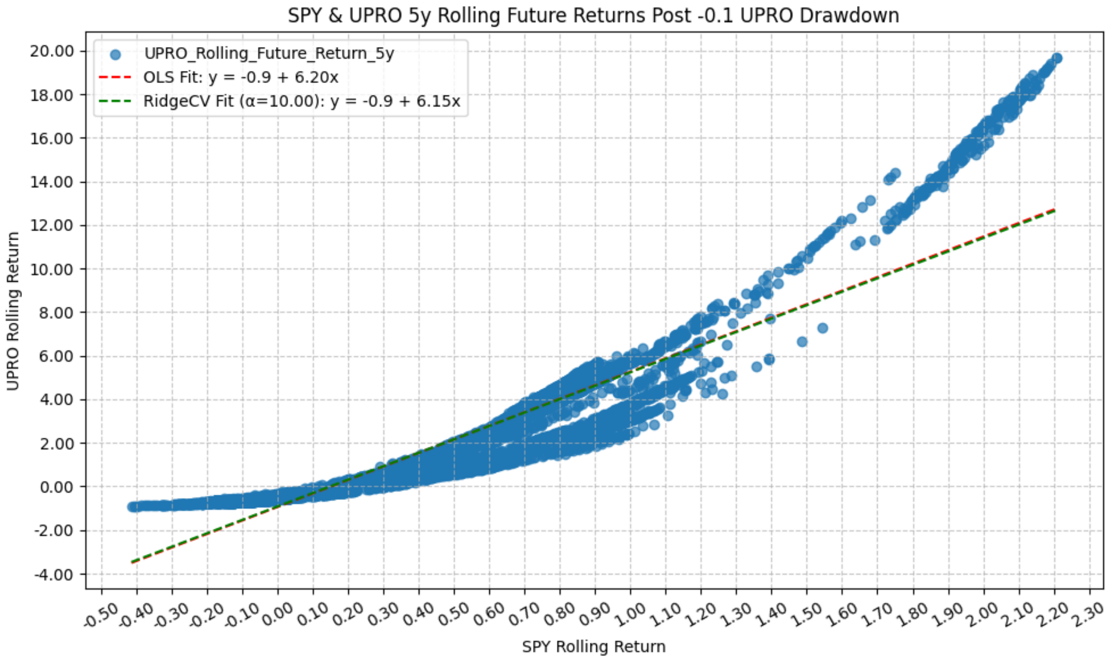





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_4y   R-squared:
0.849
Model:                                       OLS   Adj. R-squared:
0.849
Method:                            Least Squares   F-statistic:
3.112e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:17   Log-Likelihood:
-7257.5
No. Observations:                           5557   AIC:
1.452e+04
Df Residuals:                               5555   BIC:
1.453e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.4417      0.016    -27.325      0.000
```

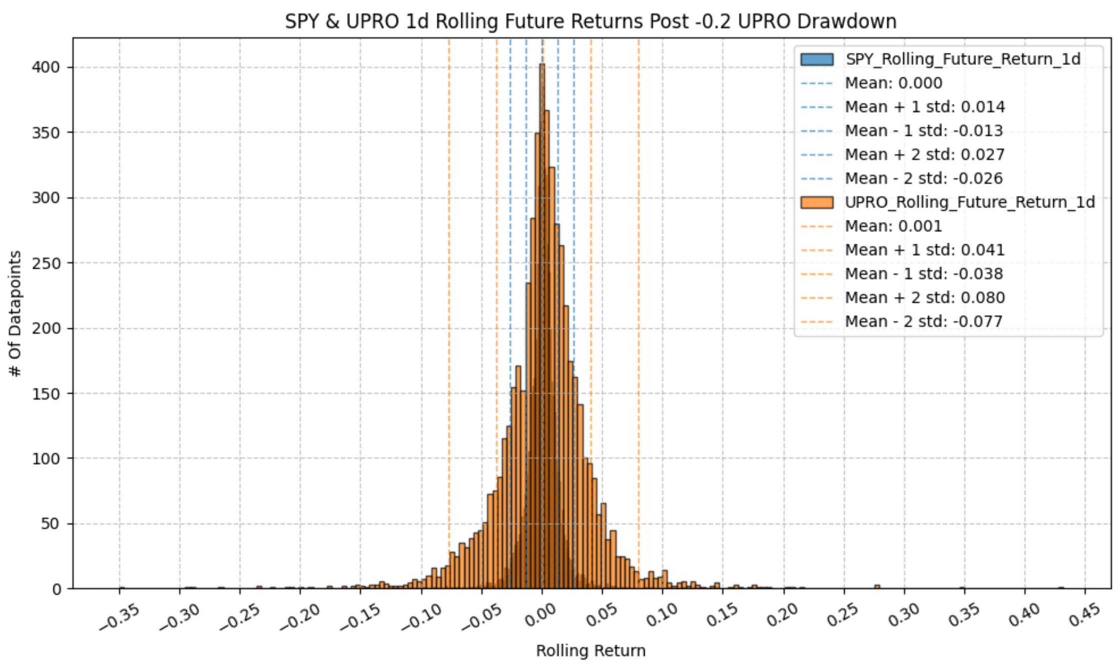
```
-0.473      -0.410
SPY_Rolling_Future_Return_4y     5.1530      0.029    176.414      0.000
5.096       5.210
==============================================================================
Omnibus:                     1907.776   Durbin-Watson:                   0.013
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            10169.158
Skew:                           1.554   Prob(JB):                         0.00
Kurtosis:                       8.853   Cond. No.                         2.83
==============================================================================

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

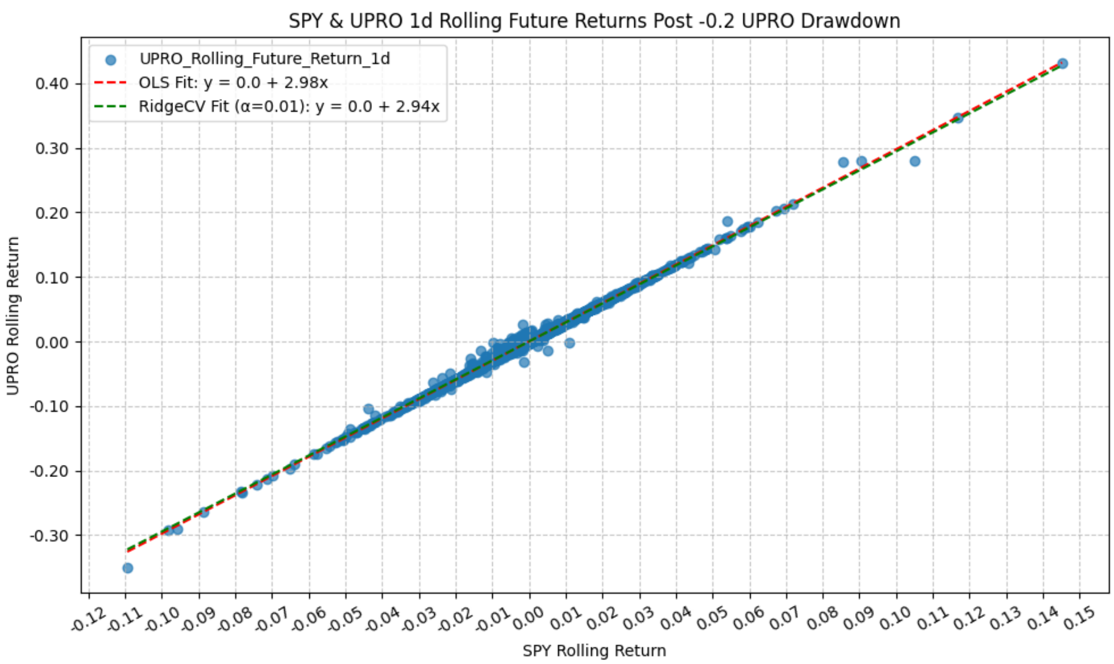





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_5y   R-squared:
0.838
Model:                                       OLS   Adj. R-squared:
0.838
Method:                            Least Squares   F-statistic:
2.842e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:18   Log-Likelihood:
-9617.9
No. Observations:                           5508   AIC:
1.924e+04
Df Residuals:                               5506   BIC:
1.925e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                         -0.9357      0.026    -35.724      0.000
```

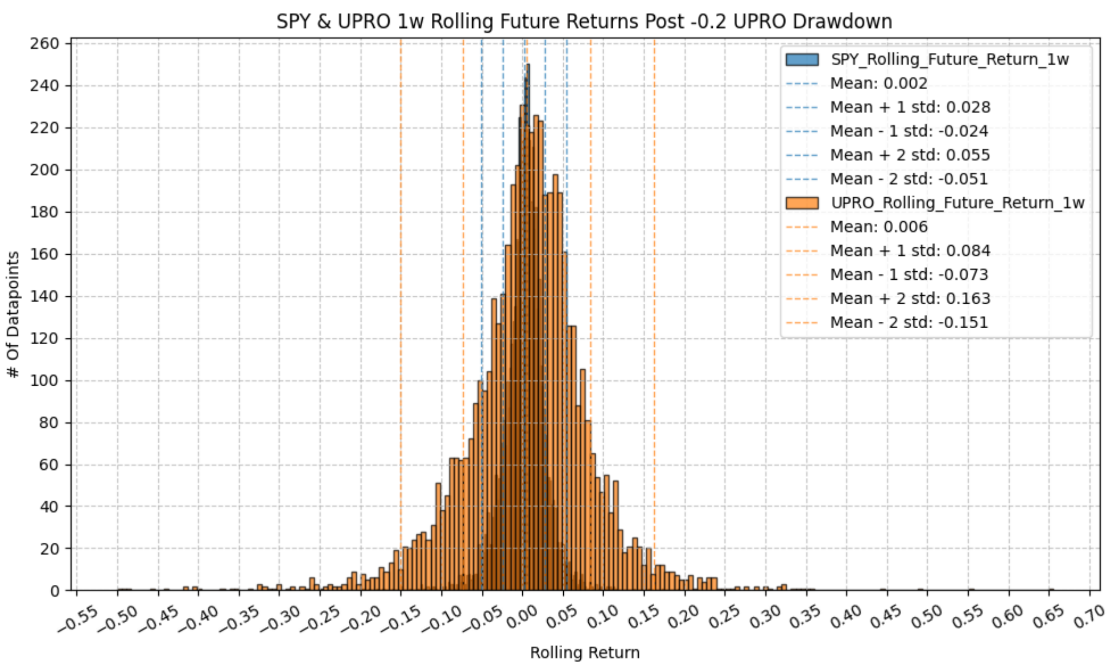
```
-0.987      -0.884
SPY_Rolling_Future_Return_5y     6.1980      0.037    168.589      0.000
6.126       6.270
==============================================================================
Omnibus:                     1244.876   Durbin-Watson:                   0.010
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4373.621
Skew:                           1.109   Prob(JB):                         0.00
Kurtosis:                       6.760   Cond. No.                         2.58
==============================================================================

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

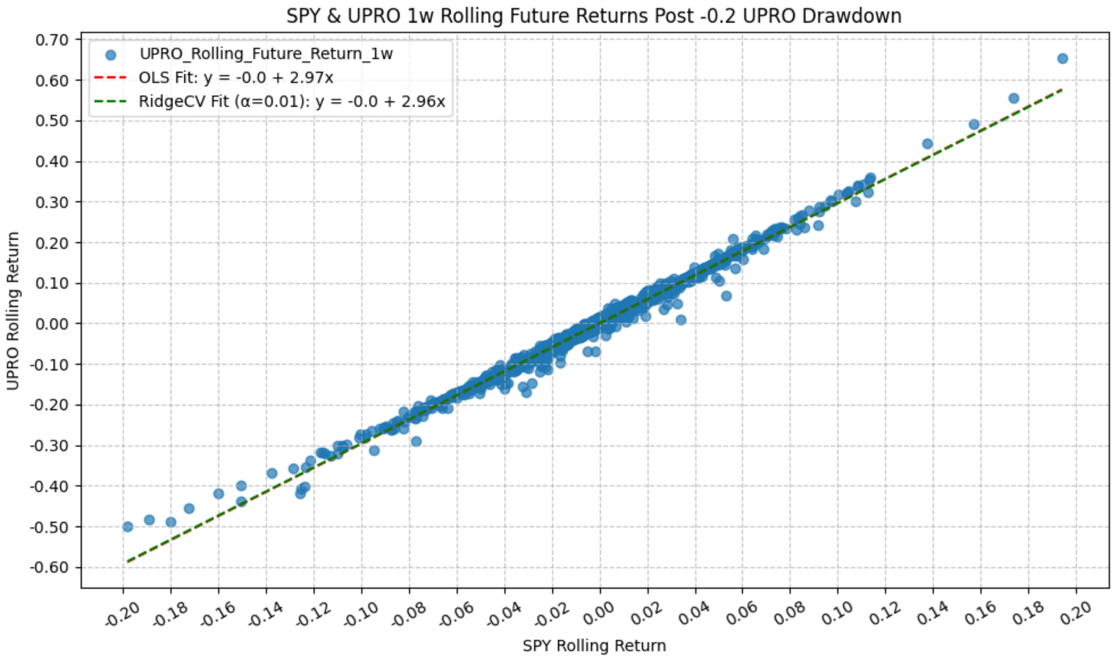





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1d   R-squared:
0.997
Model:                                       OLS   Adj. R-squared:
0.997
Method:                            Least Squares   F-statistic:
1.837e+06
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:19   Log-Likelihood:
25121.
No. Observations:                           5293   AIC:
-5.024e+04
Df Residuals:                               5291   BIC:
-5.023e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                        3.561e-05   2.89e-05      1.232      0.218
```

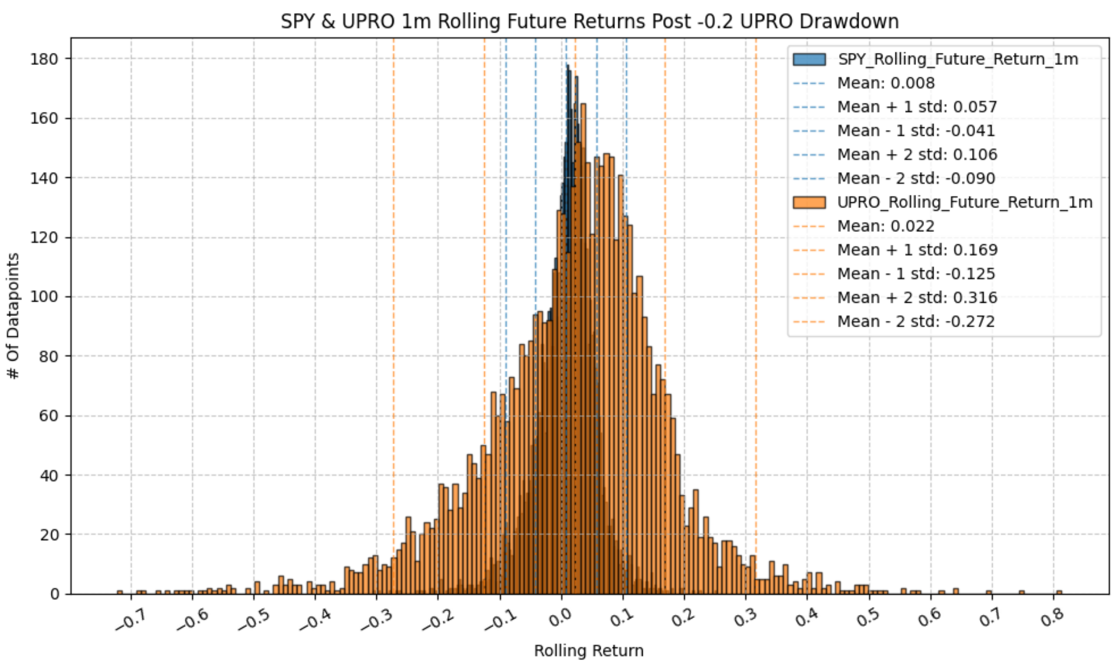
```
-2.11e-05    9.23e-05
SPY_Rolling_Future_Return_1d     2.9772      0.002    1355.226      0.000
2.973       2.981
==============================================================================
Omnibus:                     3682.706   Durbin-Watson:                   2.648
Prob(Omnibus):                  0.000   Jarque-Bera (JB):          1787435.938
Skew:                           2.082   Prob(JB):                         0.00
Kurtosis:                      92.930   Cond. No.                         76.0
==============================================================================

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

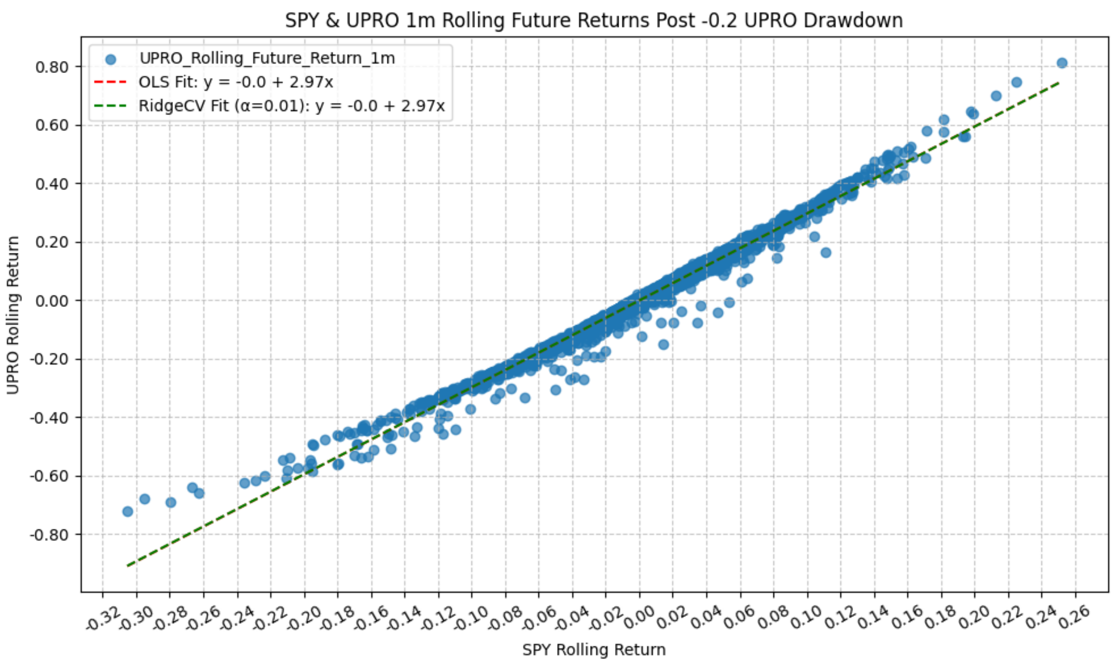





```
                                  OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1w   R-squared:
0.993
Model:                                       OLS   Adj. R-squared:
0.993
Method:                            Least Squares   F-statistic:
7.714e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:20   Log-Likelihood:
19160.
No. Observations:                           5293   AIC:
-3.832e+04
Df Residuals:                               5291   BIC:
-3.830e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0002   8.94e-05     -2.240      0.025
```

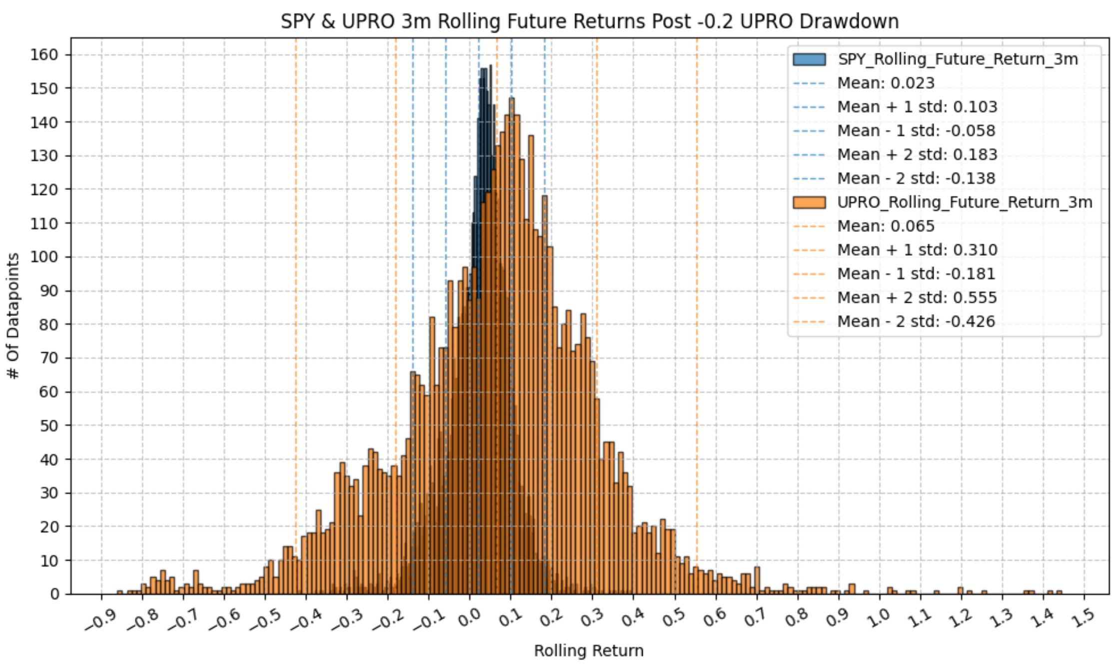
```
-0.000     -2.5e-05
SPY_Rolling_Future_Return_1w      2.9708       0.003     878.276       0.000
2.964       2.977
==============================================================================
Omnibus:                     2333.089   Durbin-Watson:                   0.986
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           564965.860
Skew:                          -0.921   Prob(JB):                         0.00
Kurtosis:                      53.580   Cond. No.                         38.0
==============================================================================

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

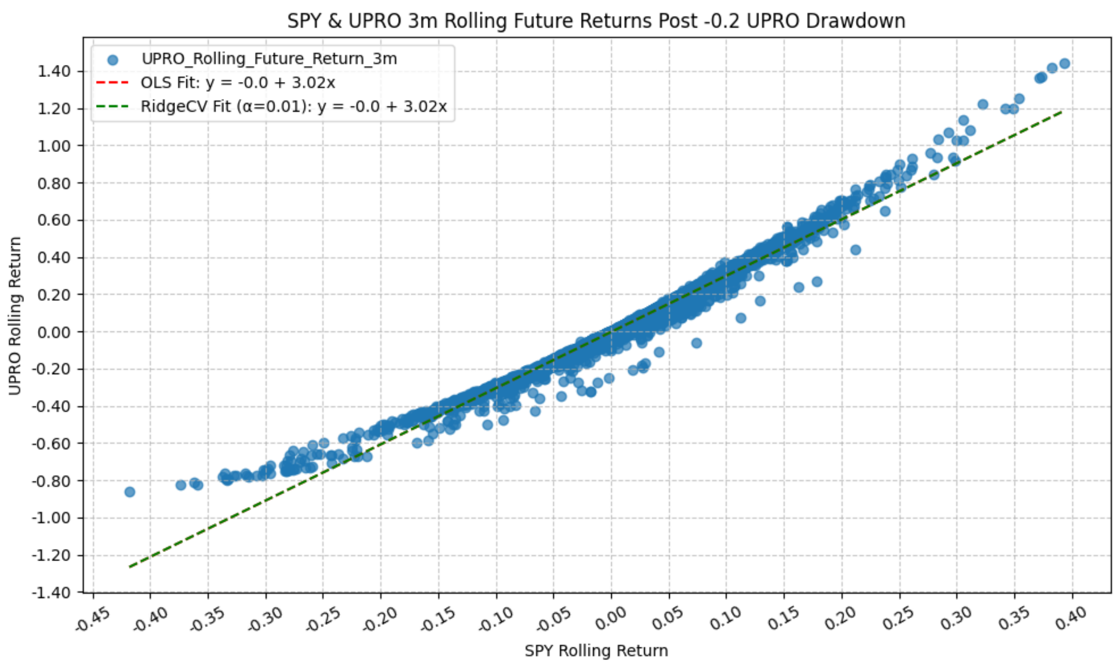





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1m   R-squared:
0.987
Model:                                       OLS   Adj. R-squared:
0.987
Method:                            Least Squares   F-statistic:
4.024e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:21   Log-Likelihood:
14137.
No. Observations:                           5293   AIC:
-2.827e+04
Df Residuals:                               5291   BIC:
-2.826e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.0014      0.000     -6.033      0.000
```

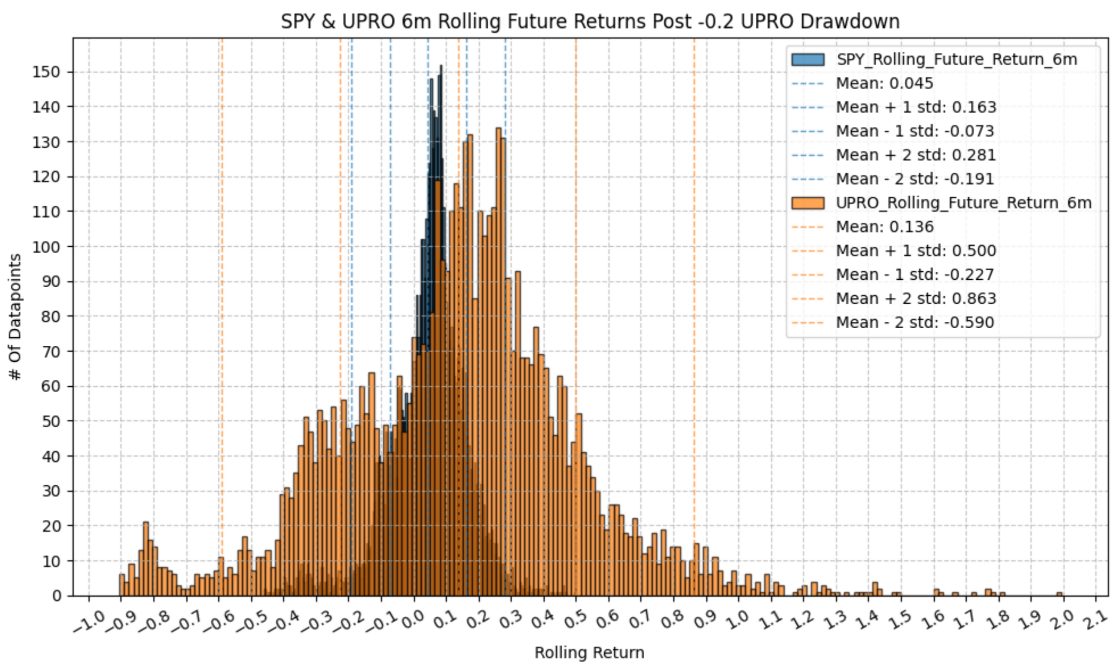
```
-0.002      -0.001
SPY_Rolling_Future_Return_1m     2.9716      0.005    634.375      0.000
2.962       2.981
==============================================================================
Omnibus:                     2857.215   Durbin-Watson:                   0.332
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           280080.687
Skew:                          -1.658   Prob(JB):                         0.00
Kurtosis:                      38.482   Cond. No.                         20.4
==============================================================================

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

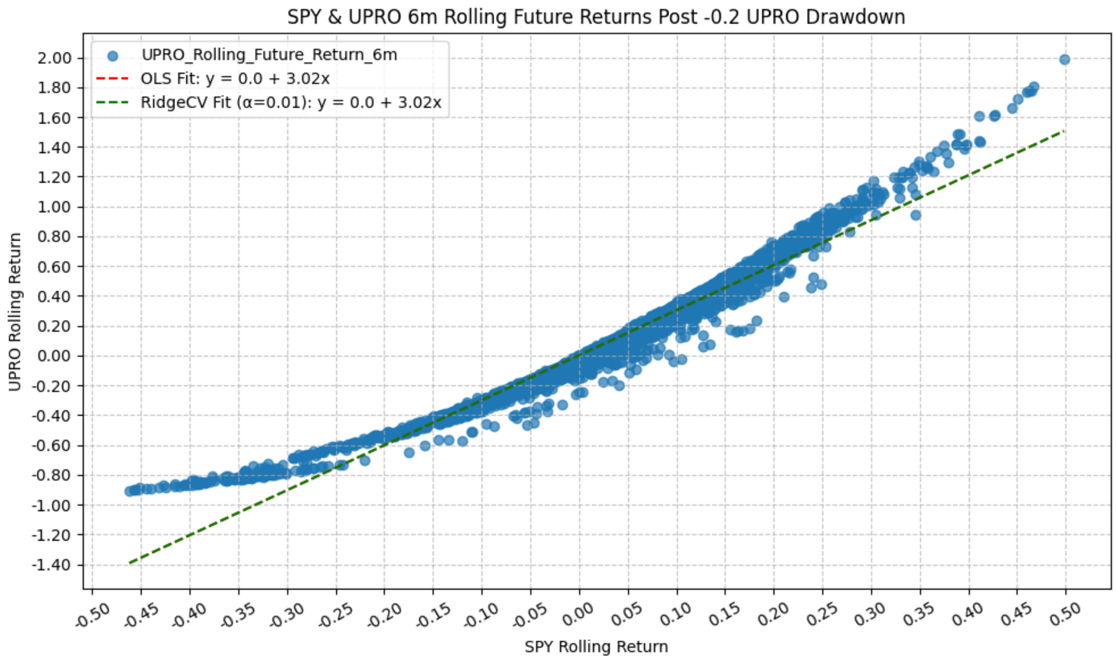





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3m   R-squared:
0.977
Model:                                       OLS   Adj. R-squared:
0.977
Method:                            Least Squares   F-statistic:
2.274e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:23   Log-Likelihood:
9942.2
No. Observations:                           5293   AIC:
-1.988e+04
Df Residuals:                               5291   BIC:
-1.987e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0036      0.001     -6.764      0.000
```

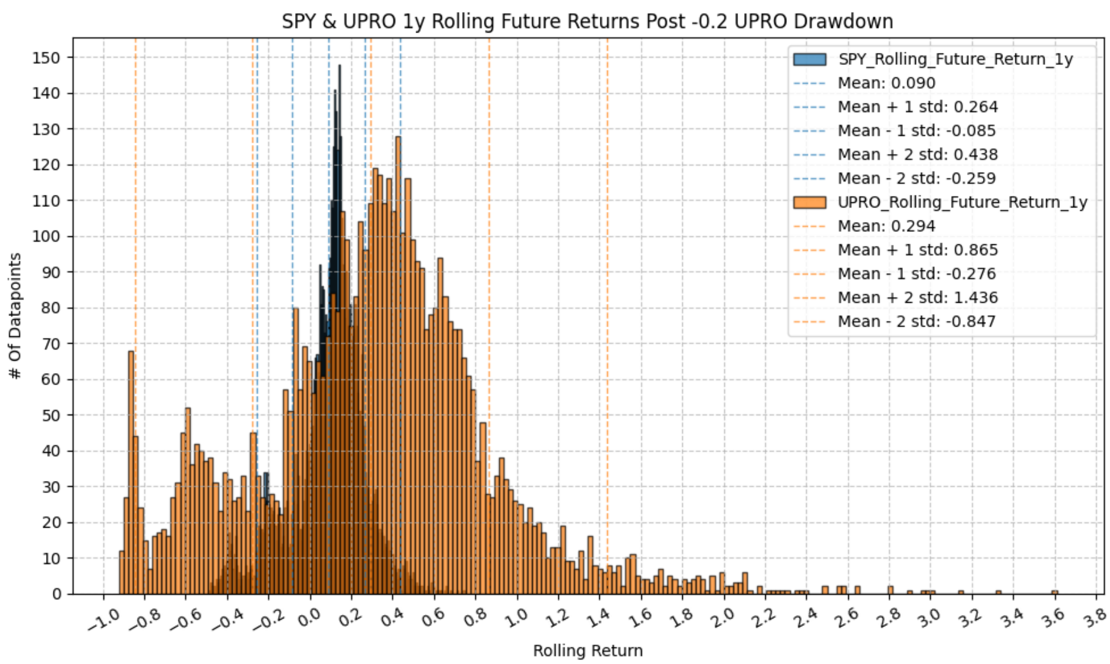
```
-0.005      -0.003
SPY_Rolling_Future_Return_3m     3.0230      0.006    476.832      0.000
3.011       3.035
==============================================================================
Omnibus:                     1416.233   Durbin-Watson:                   0.159
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            70537.930
Skew:                           0.467   Prob(JB):                         0.00
Kurtosis:                      20.860   Cond. No.                         12.5
==============================================================================

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

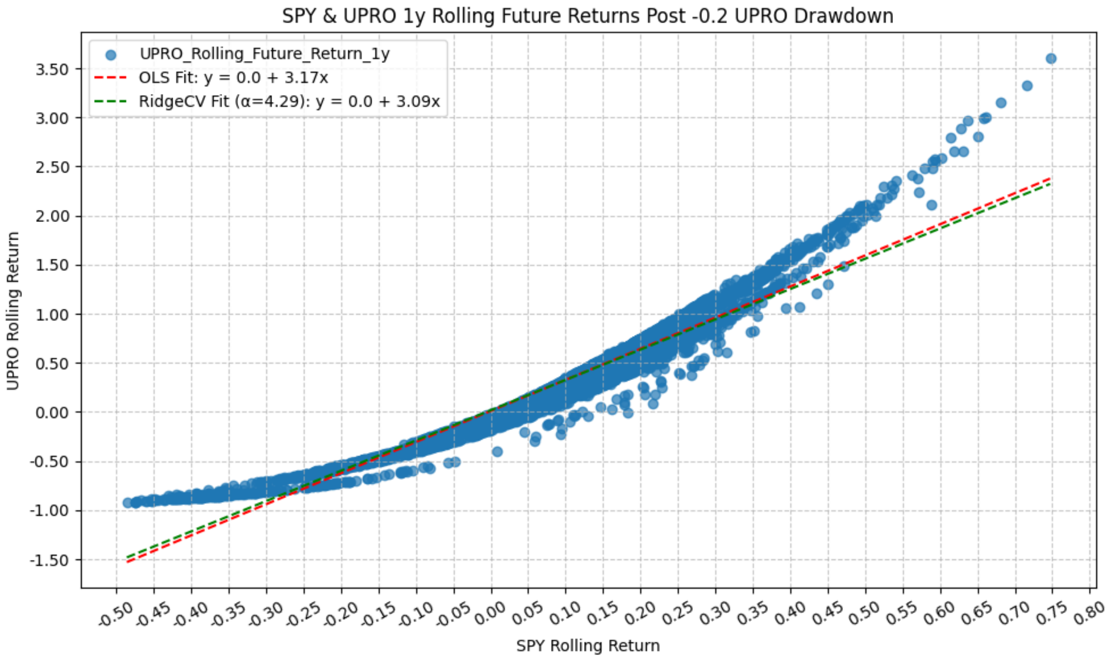





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_6m   R-squared:
0.960
Model:                                       OLS   Adj. R-squared:
0.960
Method:                            Least Squares   F-statistic:
1.281e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:24   Log-Likelihood:
6392.3
No. Observations:                           5293   AIC:
-1.278e+04
Df Residuals:                               5291   BIC:
-1.277e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                            0.0016      0.001      1.525      0.127
```

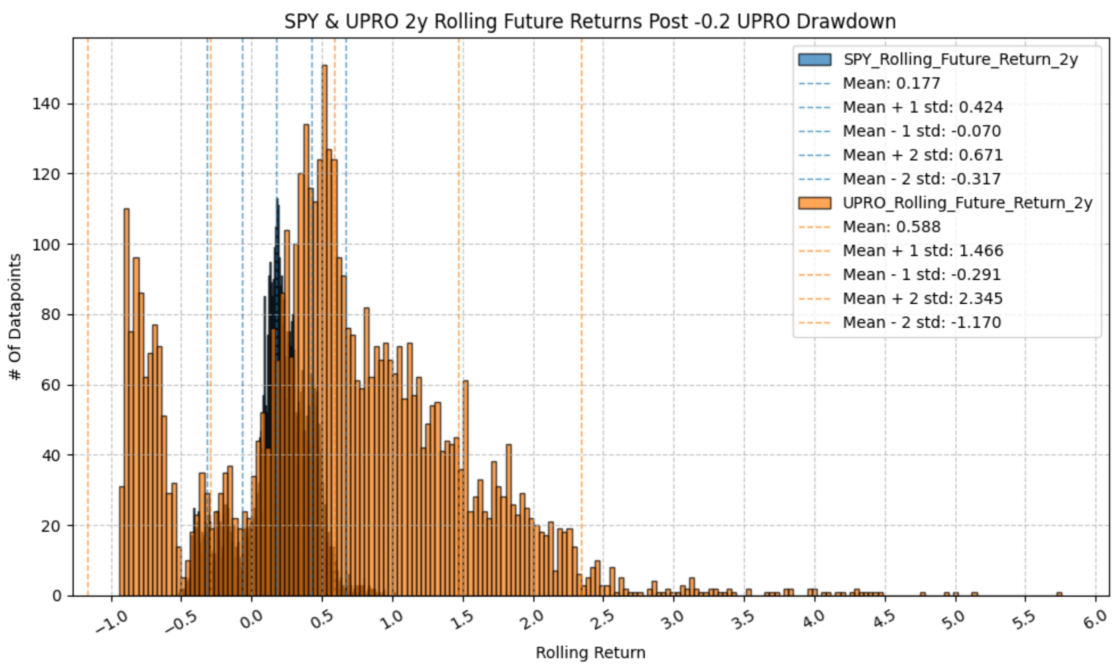
```
-0.000       0.004
SPY_Rolling_Future_Return_6m     3.0177      0.008    357.941      0.000
3.001       3.034
==============================================================================
Omnibus:                     1752.103   Durbin-Watson:                   0.078
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            16365.764
Skew:                           1.309   Prob(JB):                         0.00
Kurtosis:                      11.207   Cond. No.                         8.50
==============================================================================

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

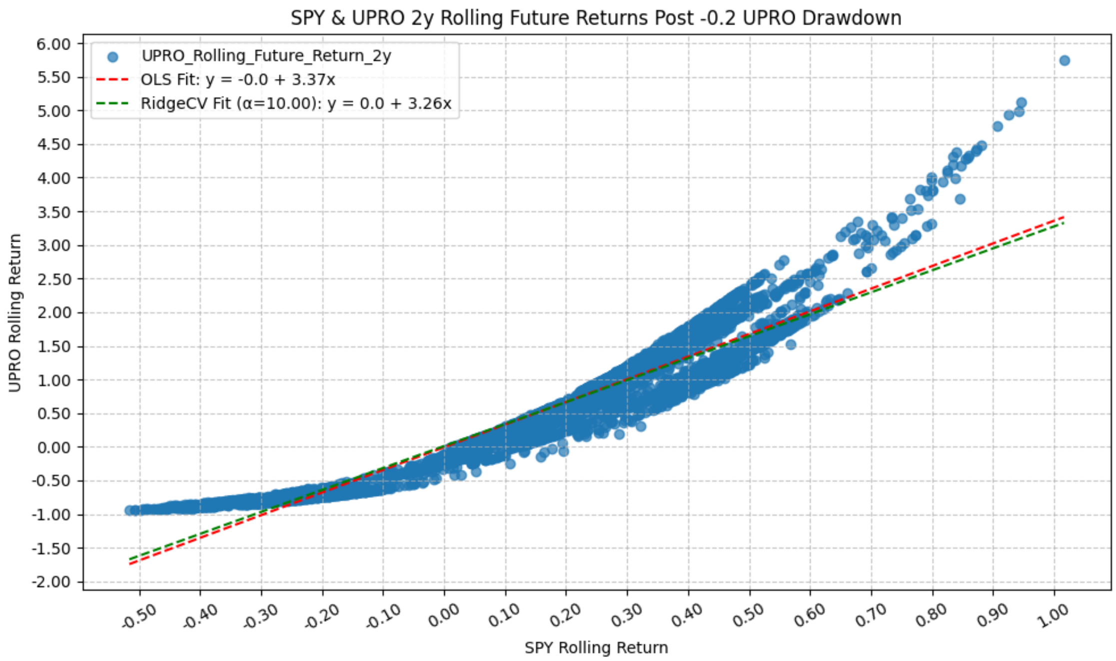





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1y   R-squared:
0.937
Model:                                       OLS   Adj. R-squared:
0.937
Method:                            Least Squares   F-statistic:
7.757e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:25   Log-Likelihood:
2737.3
No. Observations:                           5248   AIC:
-5471.
Df Residuals:                               5246   BIC:
-5457.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           0.0101      0.002      4.550      0.000
```

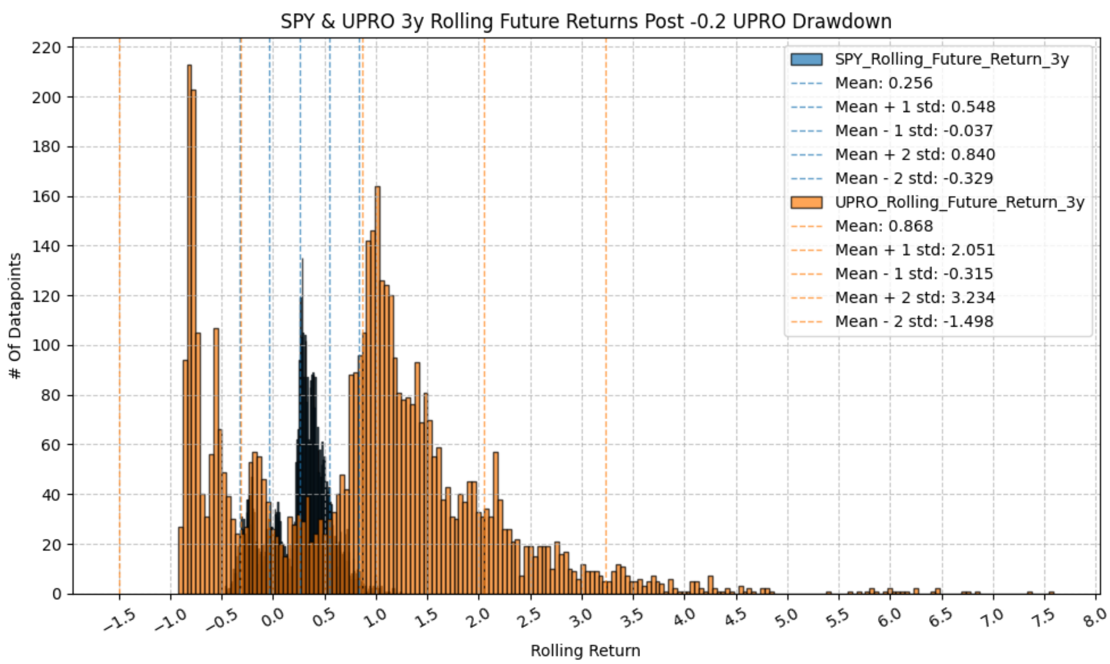
```
0.006       0.015
SPY_Rolling_Future_Return_1y     3.1690      0.011    278.518      0.000
3.147       3.191
==============================================================================
Omnibus:                     1724.713   Durbin-Watson:                   0.051
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             9895.182
Skew:                           1.453   Prob(JB):                         0.00
Kurtosis:                       9.066   Cond. No.                         5.79
==============================================================================

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

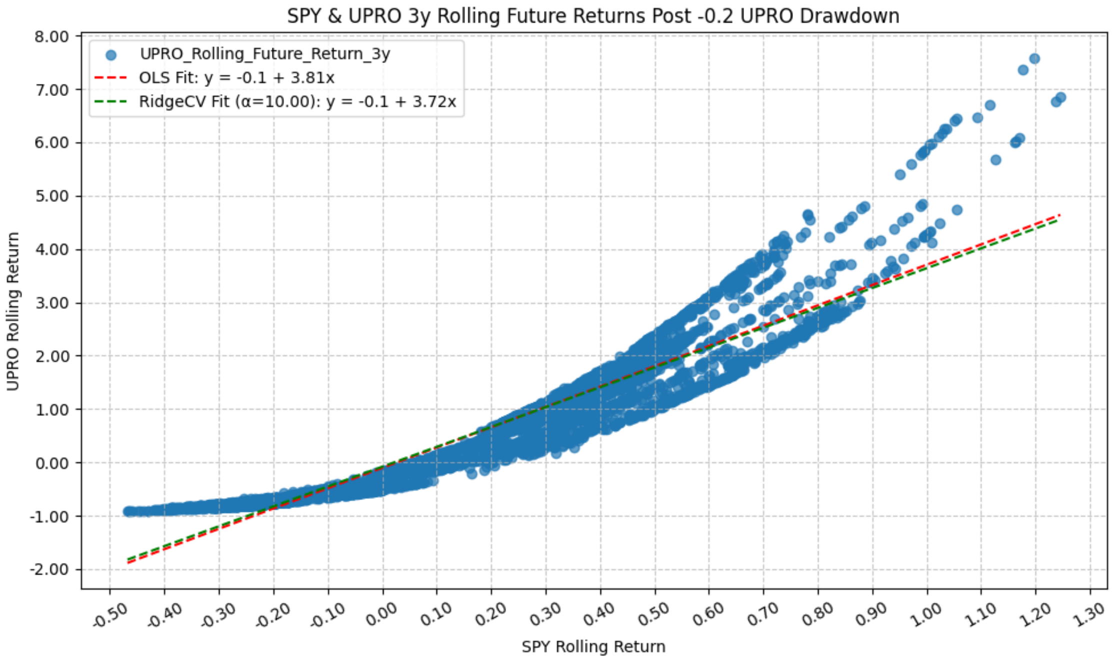





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_2y   R-squared:
0.895
Model:                                       OLS   Adj. R-squared:
0.895
Method:                            Least Squares   F-statistic:
4.481e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:26   Log-Likelihood:
-840.74
No. Observations:                           5235   AIC:
1685.
Df Residuals:                               5233   BIC:
1699.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0069      0.005     -1.420      0.156
```

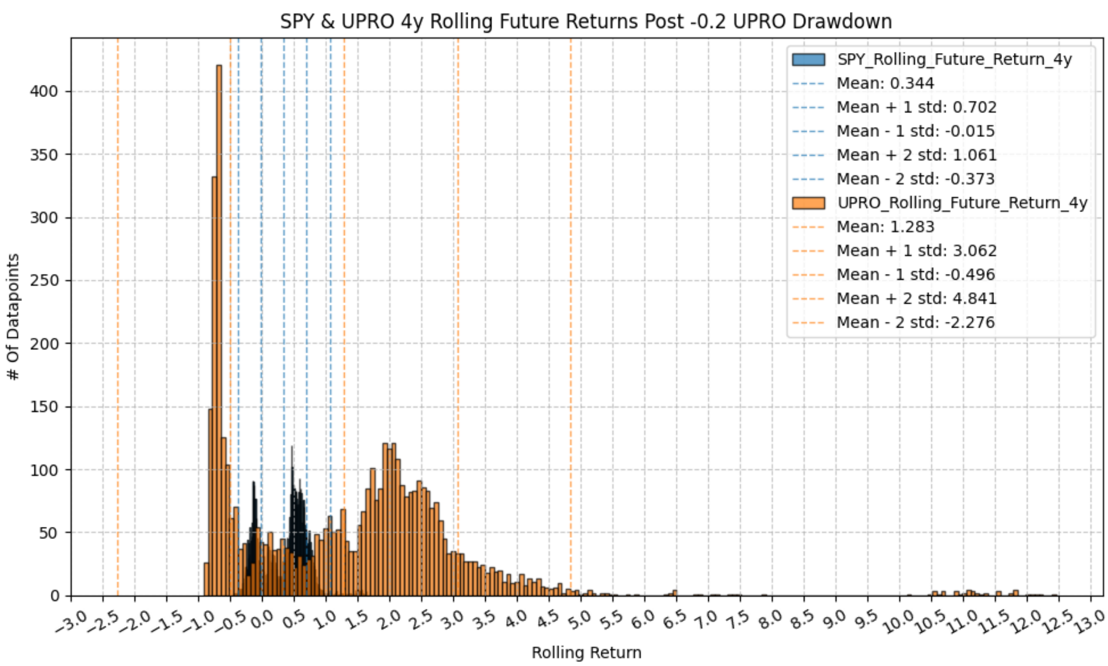
```
-0.016      0.003
SPY_Rolling_Future_Return_2y     3.3654      0.016    211.679      0.000
3.334      3.397
==============================================================================
Omnibus:                     1350.050   Durbin-Watson:                   0.031
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4692.366
Skew:                           1.271   Prob(JB):                         0.00
Kurtosis:                       6.879   Cond. No.                         4.18
==============================================================================

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

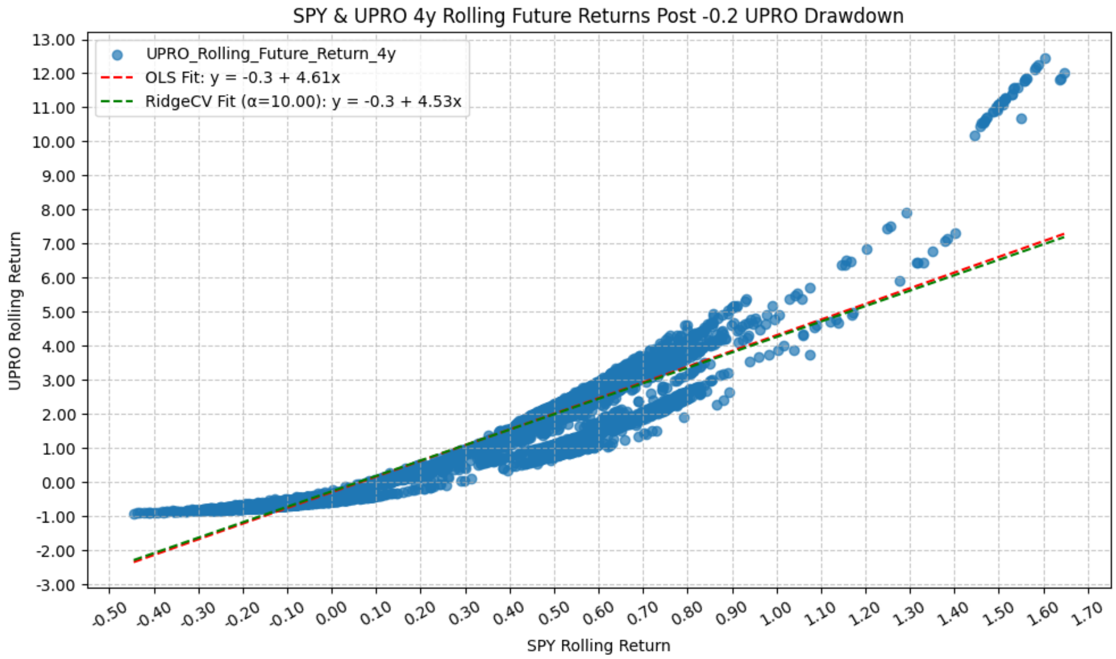





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3y   R-squared:
0.885
Model:                                       OLS   Adj. R-squared:
0.885
Method:                            Least Squares   F-statistic:
3.849e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:27   Log-Likelihood:
-2524.0
No. Observations:                           4998   AIC:
5052.
Df Residuals:                               4996   BIC:
5065.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.1052      0.008    -13.955      0.000
```

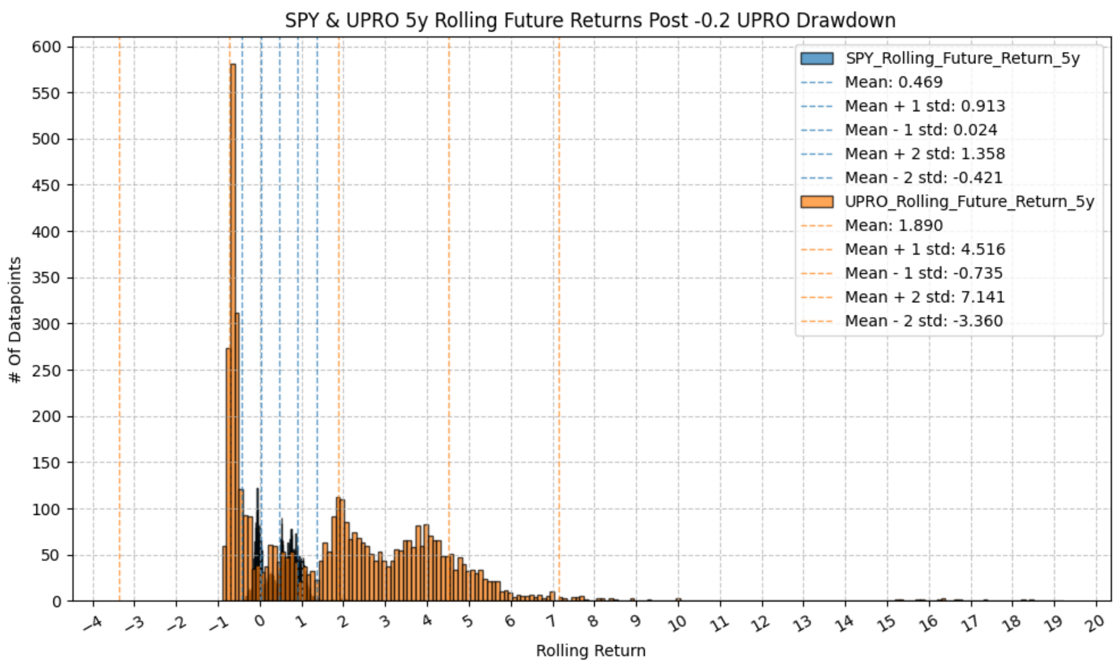
```
-0.120      -0.090
SPY_Rolling_Future_Return_3y     3.8081      0.019    196.192      0.000
3.770       3.846
==============================================================================
Omnibus:                     1497.695   Durbin-Watson:                   0.020
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             8214.199
Skew:                           1.324   Prob(JB):                         0.00
Kurtosis:                       8.695   Cond. No.                         3.66
==============================================================================

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

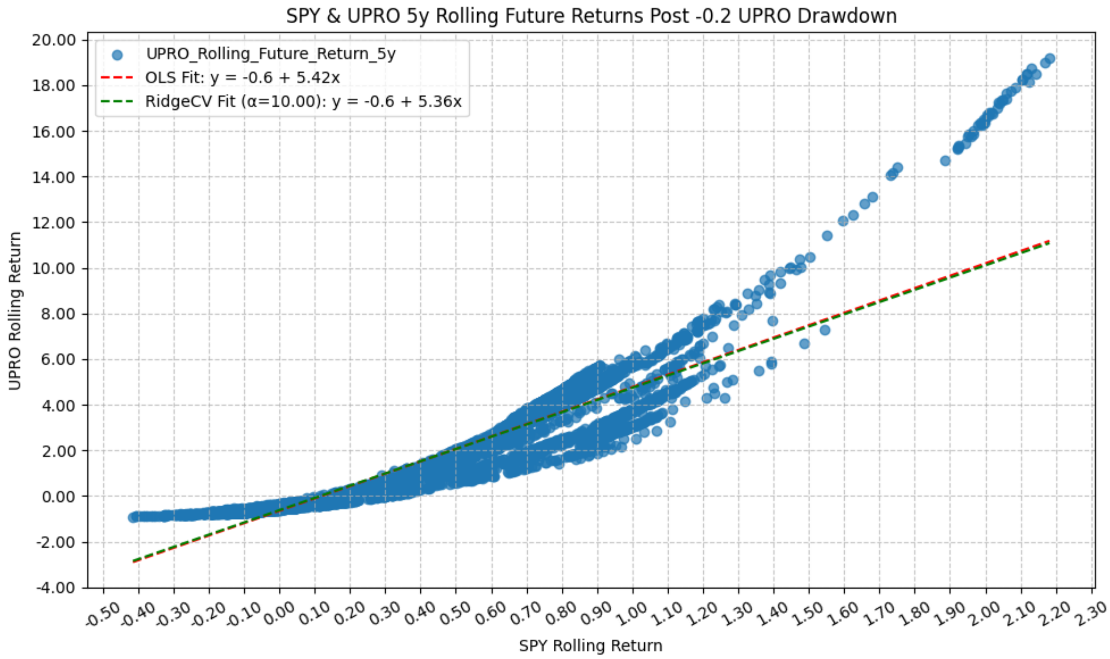





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_4y   R-squared:
0.862
Model:                                       OLS   Adj. R-squared:
0.862
Method:                            Least Squares   F-statistic:
2.963e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:28   Log-Likelihood:
-4784.4
No. Observations:                           4757   AIC:
9573.
Df Residuals:                               4755   BIC:
9586.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.3002      0.013    -22.587      0.000
```

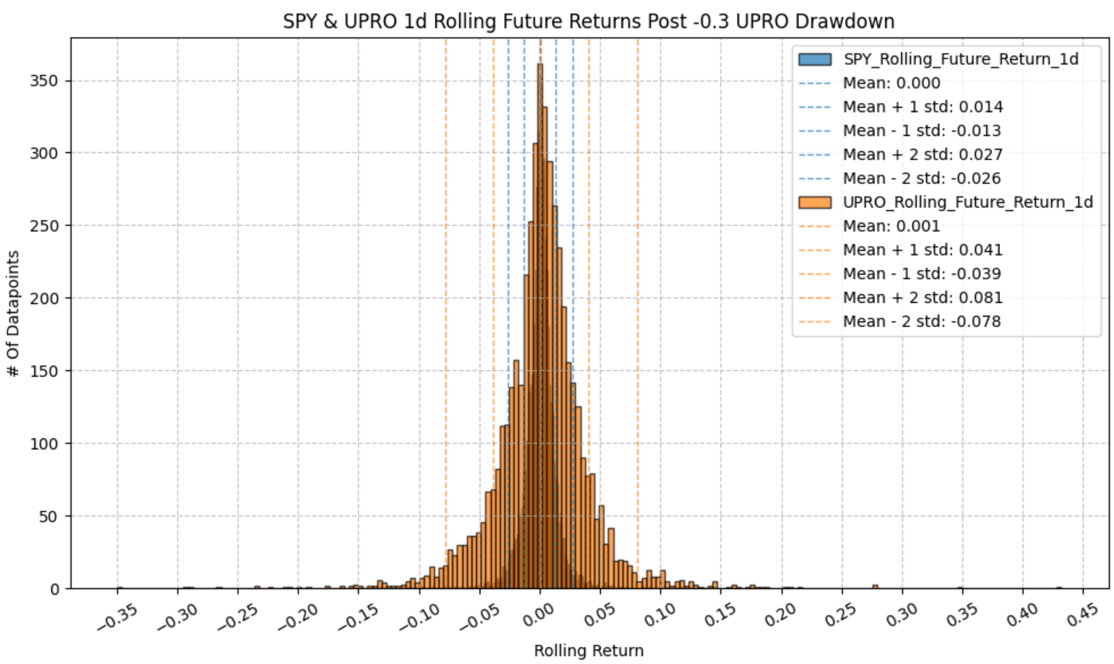
```
-0.326      -0.274
SPY_Rolling_Future_Return_4y     4.6068      0.027    172.137      0.000
4.554       4.659
==============================================================================
Omnibus:                     2932.099   Durbin-Watson:                   0.020
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            69932.785
Skew:                           2.518   Prob(JB):                         0.00
Kurtosis:                      21.096   Cond. No.                         3.16
==============================================================================

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

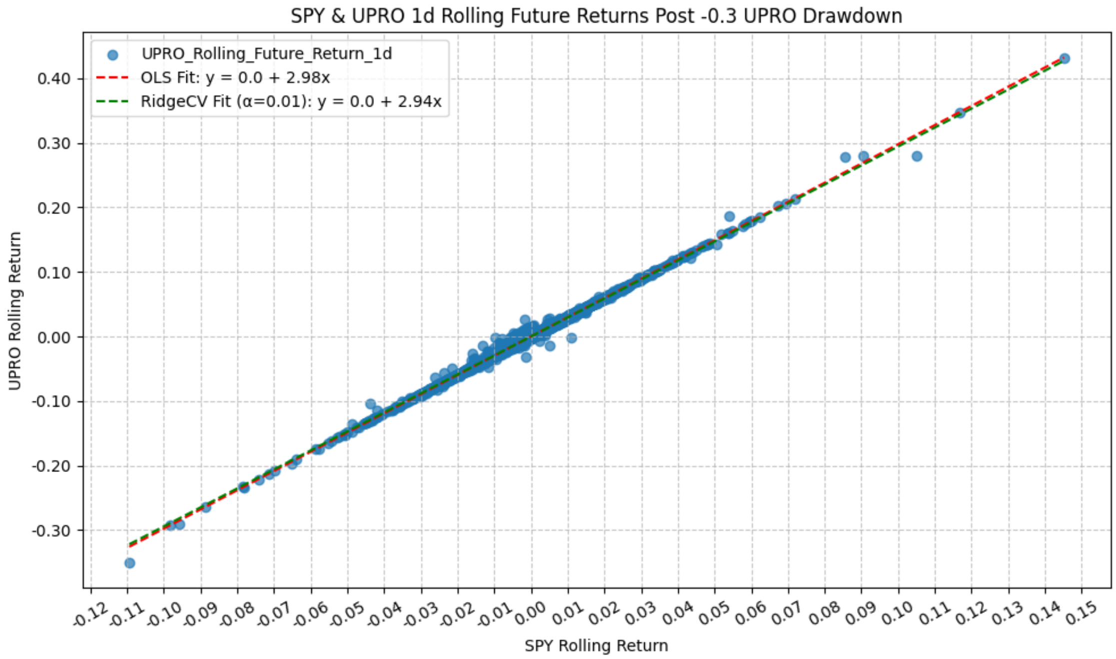





```
                                 OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_5y   R-squared:
0.842
Model:                                       OLS   Adj. R-squared:
0.842
Method:                            Least Squares   F-statistic:
2.529e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:30   Log-Likelihood:
-6916.8
No. Observations:                           4736   AIC:
1.384e+04
Df Residuals:                               4734   BIC:
1.385e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.6492      0.022    -29.490      0.000
```

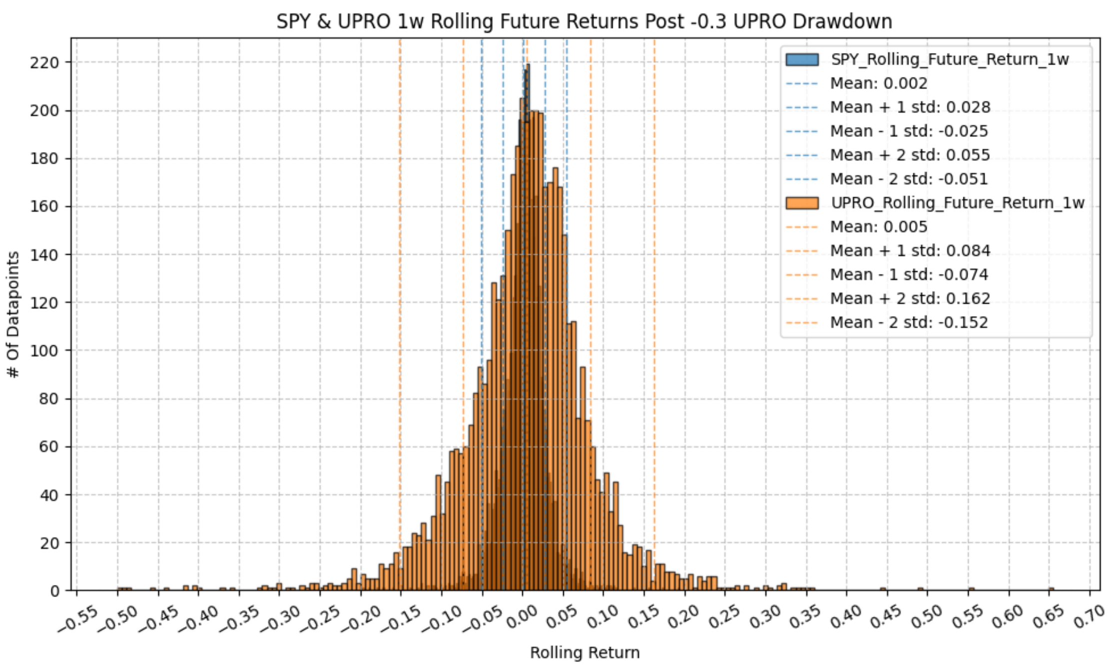
```
-0.692      -0.606
SPY_Rolling_Future_Return_5y     5.4202      0.034    159.020      0.000
5.353       5.487
==============================================================================
Omnibus:                     2512.987   Durbin-Watson:                   0.026
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            40989.263
Skew:                           2.157   Prob(JB):                         0.00
Kurtosis:                      16.751   Cond. No.                         2.84
==============================================================================

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

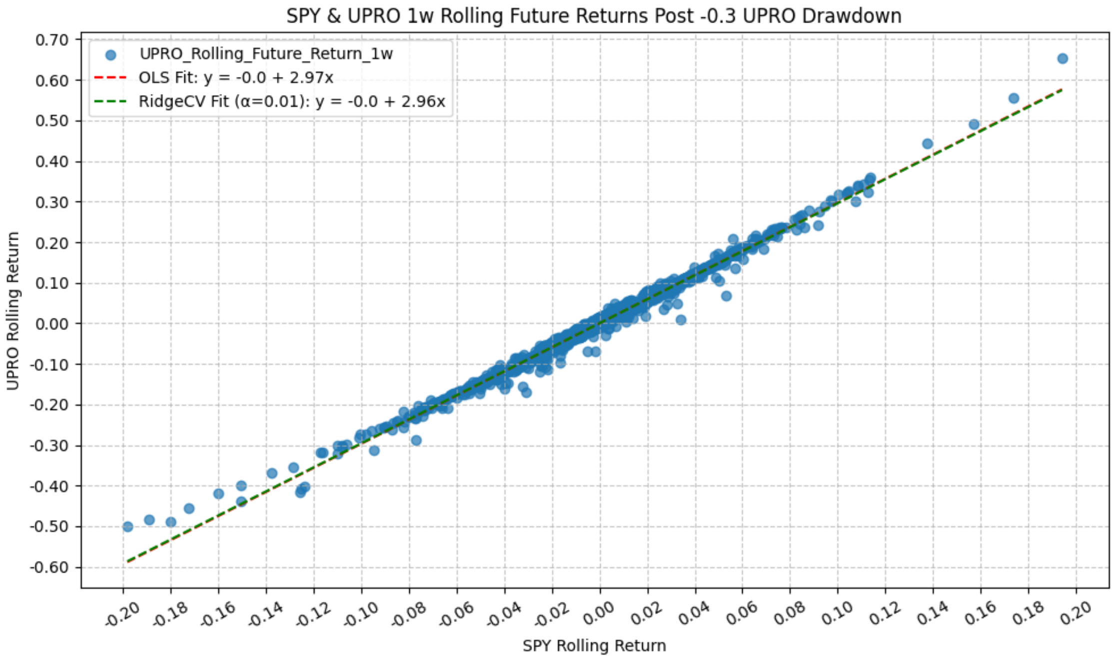





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1d   R-squared:
0.997
Model:                                       OLS   Adj. R-squared:
0.997
Method:                            Least Squares   F-statistic:
1.595e+06
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:31   Log-Likelihood:
22509.
No. Observations:                           4774   AIC:
-4.501e+04
Df Residuals:                               4772   BIC:
-4.500e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           4.7e-05   3.14e-05      1.497      0.135
```

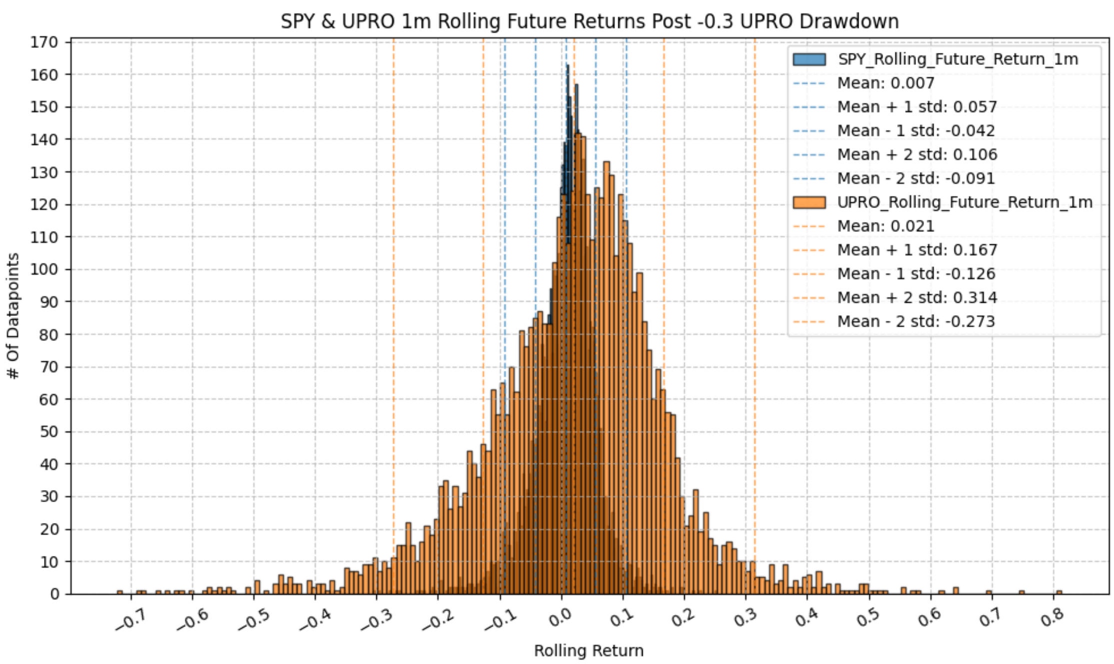
```
-1.46e-05       0.000
SPY_Rolling_Future_Return_1d     2.9768      0.002   1263.103      0.000
2.972       2.981
==============================================================================
Omnibus:                     3250.843   Durbin-Watson:                   2.668
Prob(Omnibus):                  0.000   Jarque-Bera (JB):          1511414.470
Skew:                           2.004   Prob(JB):                         0.00
Kurtosis:                      90.076   Cond. No.                         75.1
==============================================================================

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

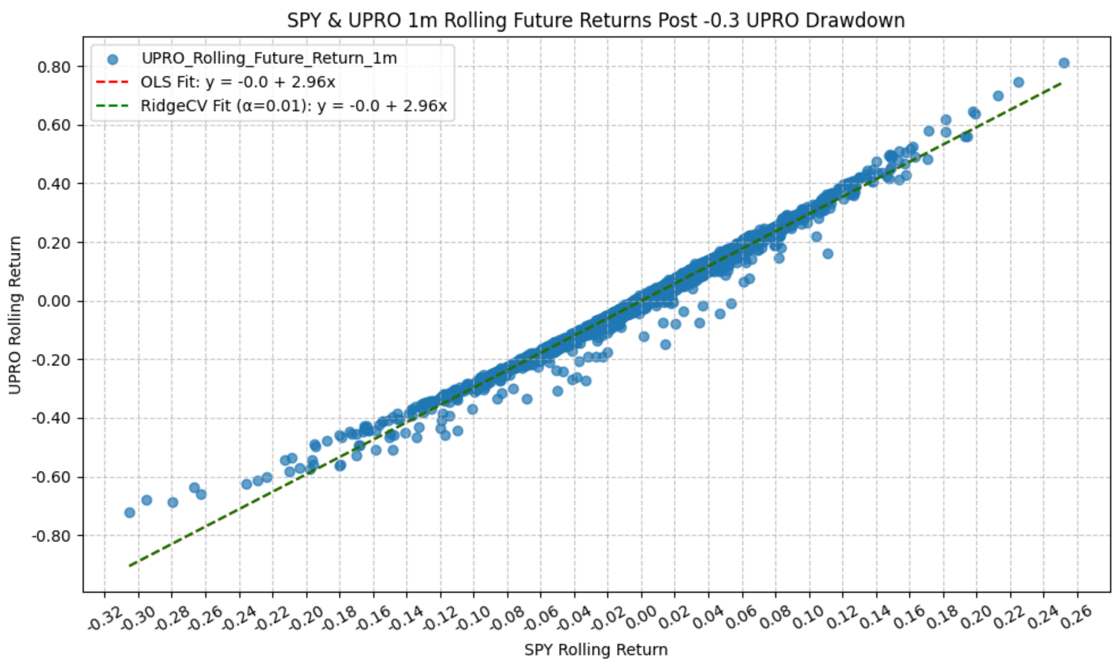





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1w   R-squared:
0.993
Model:                                       OLS   Adj. R-squared:
0.993
Method:                            Least Squares   F-statistic:
6.655e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:32   Log-Likelihood:
17170.
No. Observations:                           4774   AIC:
-3.434e+04
Df Residuals:                               4772   BIC:
-3.432e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0002   9.63e-05     -1.929      0.054
```

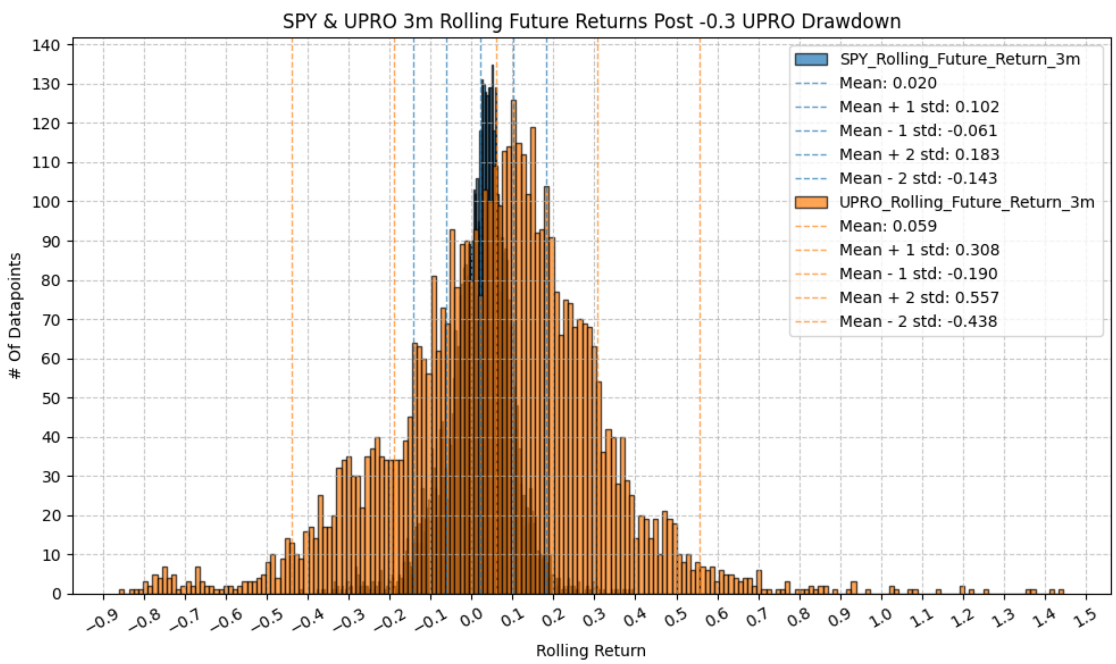
```
-0.000    2.99e-06
SPY_Rolling_Future_Return_1w     2.9716      0.004    815.801      0.000
2.964      2.979
==============================================================================
Omnibus:                     1997.752   Durbin-Watson:                   0.986
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           483400.223
Skew:                          -0.802   Prob(JB):                         0.00
Kurtosis:                      52.271   Cond. No.                         37.9
==============================================================================

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

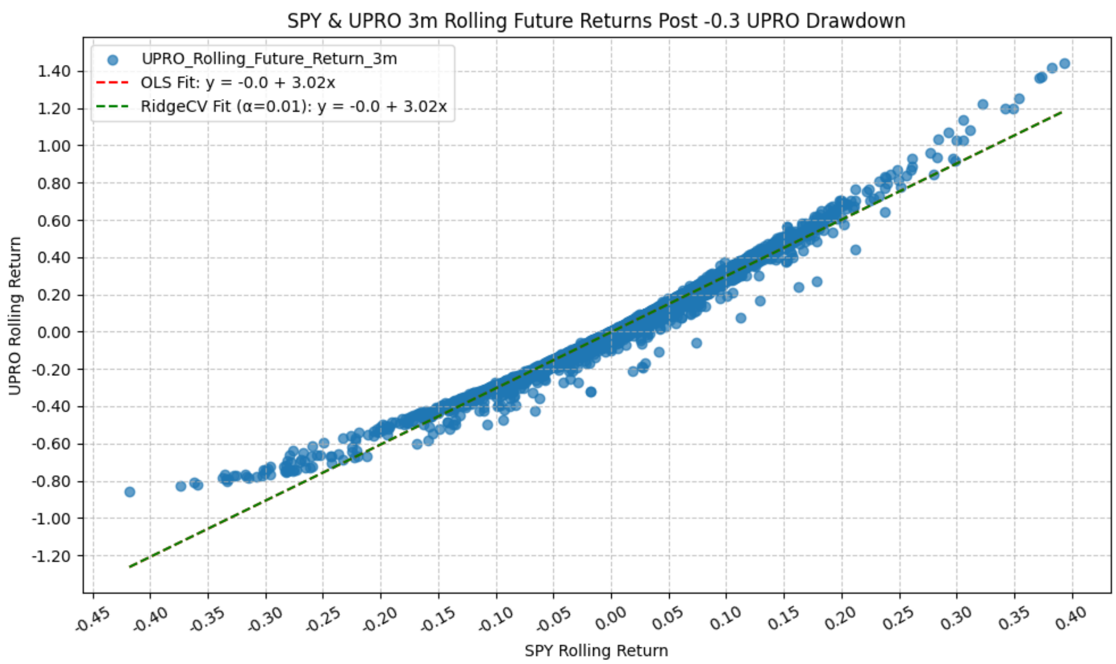





```
                                OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1m   R-squared:
0.987
Model:                                       OLS   Adj. R-squared:
0.987
Method:                            Least Squares   F-statistic:
3.515e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:33   Log-Likelihood:
12680.
No. Observations:                           4774   AIC:
-2.536e+04
Df Residuals:                               4772   BIC:
-2.534e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0011      0.000     -4.428      0.000
```

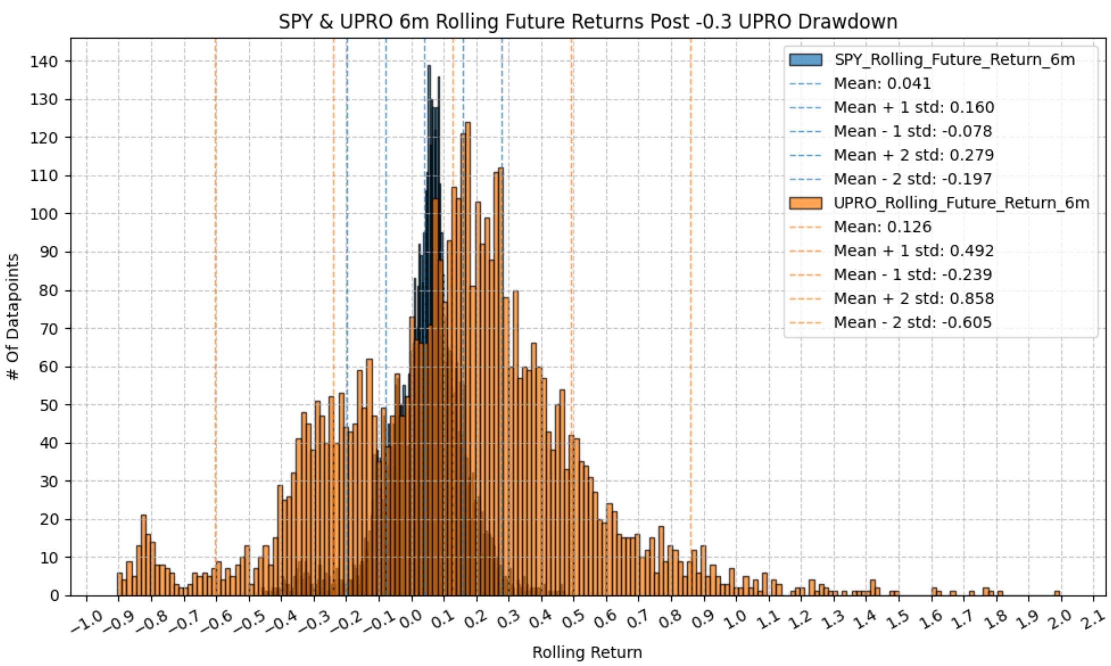
```
-0.002      -0.001
SPY_Rolling_Future_Return_1m     2.9621      0.005     592.897      0.000
2.952       2.972
==============================================================================
Omnibus:                     2677.436   Durbin-Watson:                   0.336
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           262814.760
Skew:                          -1.764   Prob(JB):                         0.00
Kurtosis:                      39.177   Cond. No.                         20.3
==============================================================================

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

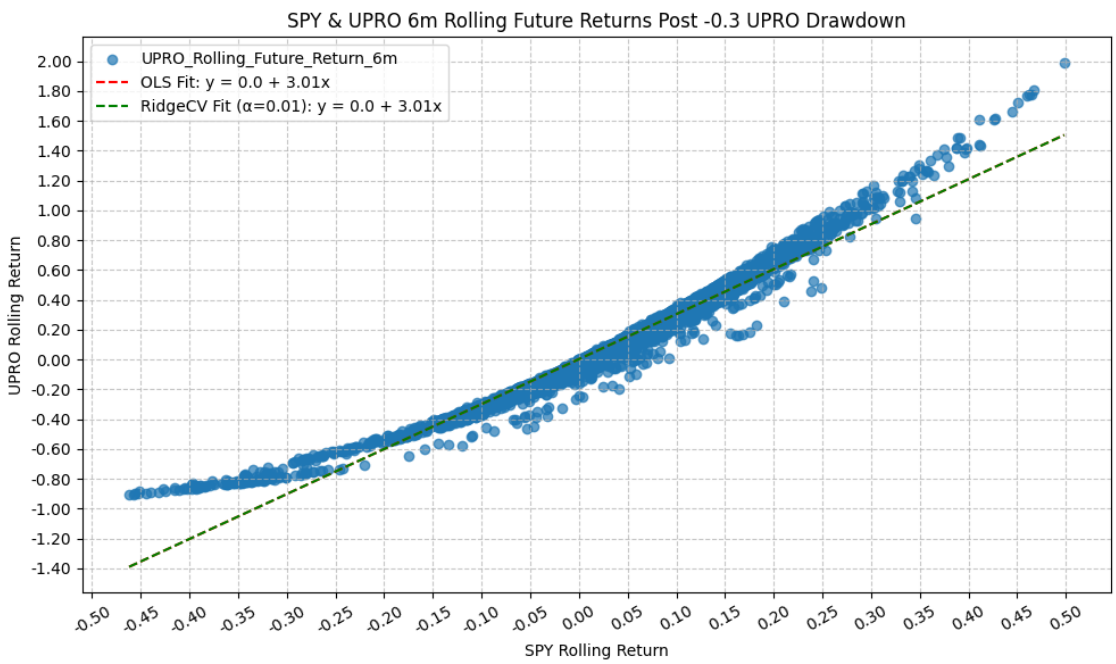





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3m   R-squared:
0.978
Model:                                       OLS   Adj. R-squared:
0.978
Method:                            Least Squares   F-statistic:
2.123e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:34   Log-Likelihood:
8982.1
No. Observations:                           4774   AIC:
-1.796e+04
Df Residuals:                               4772   BIC:
-1.795e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                               coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                       -0.0024      0.001     -4.439      0.000
```

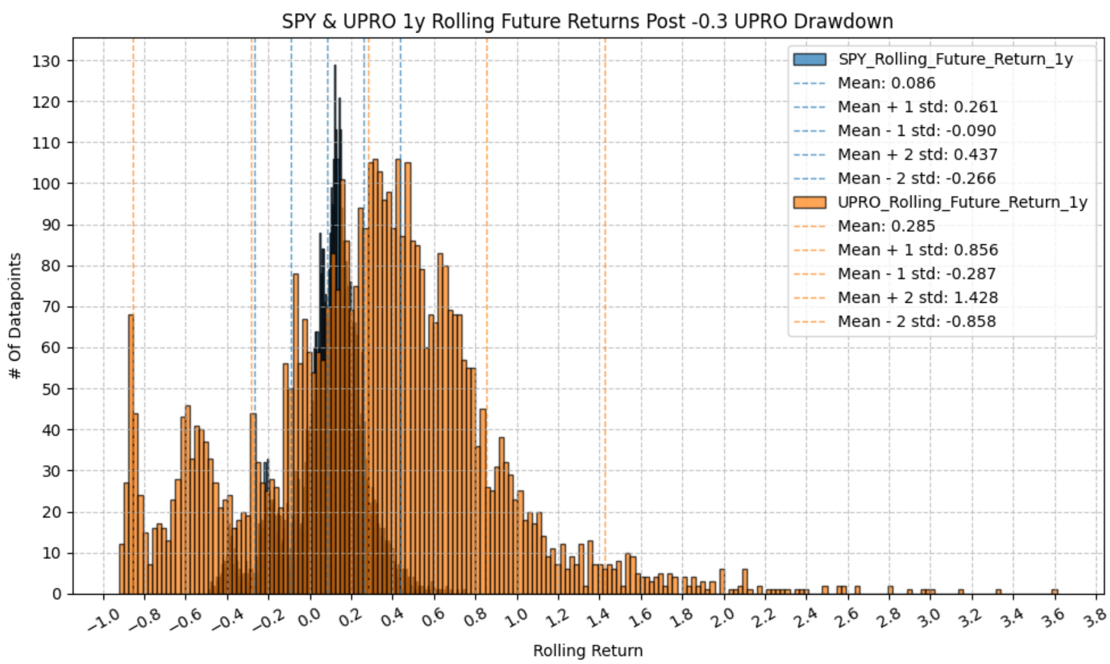
```
-0.004      -0.001
SPY_Rolling_Future_Return_3m     3.0171      0.007    460.794      0.000
3.004       3.030
==============================================================================
Omnibus:                     1429.012   Durbin-Watson:                   0.169
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            68304.492
Skew:                           0.660   Prob(JB):                         0.00
Kurtosis:                      21.483   Cond. No.                         12.3
==============================================================================

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

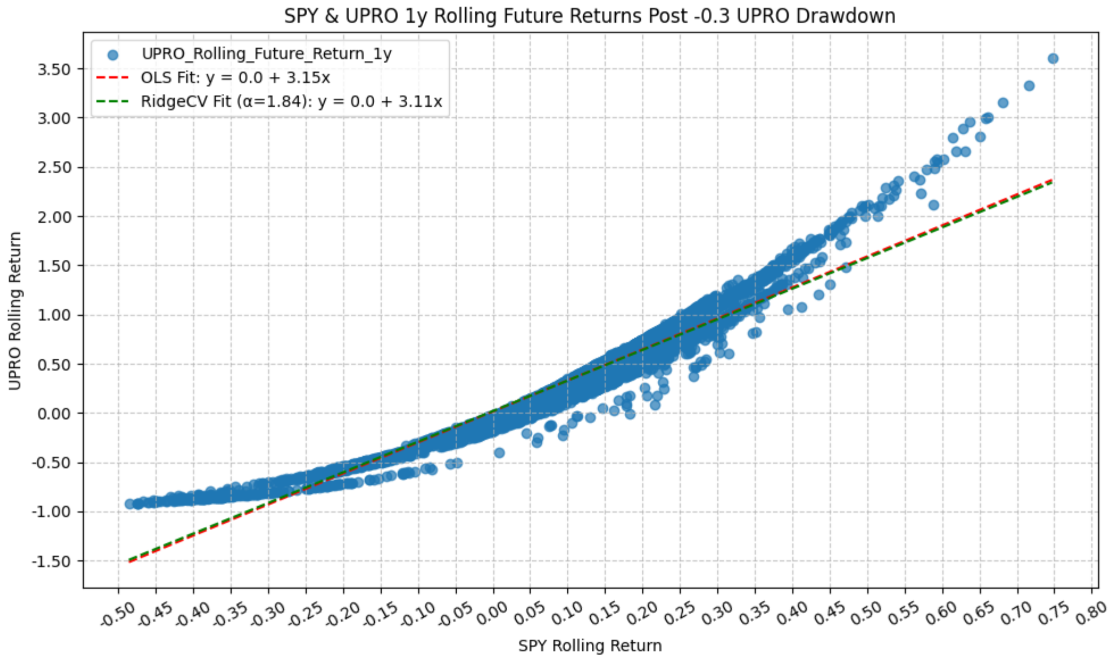





```
                                    OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_6m   R-squared:
0.960
Model:                                       OLS   Adj. R-squared:
0.960
Method:                            Least Squares   F-statistic:
1.138e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:36   Log-Likelihood:
5697.0
No. Observations:                           4774   AIC:
-1.139e+04
Df Residuals:                               4772   BIC:
-1.138e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                            0.0029      0.001      2.542      0.011
```

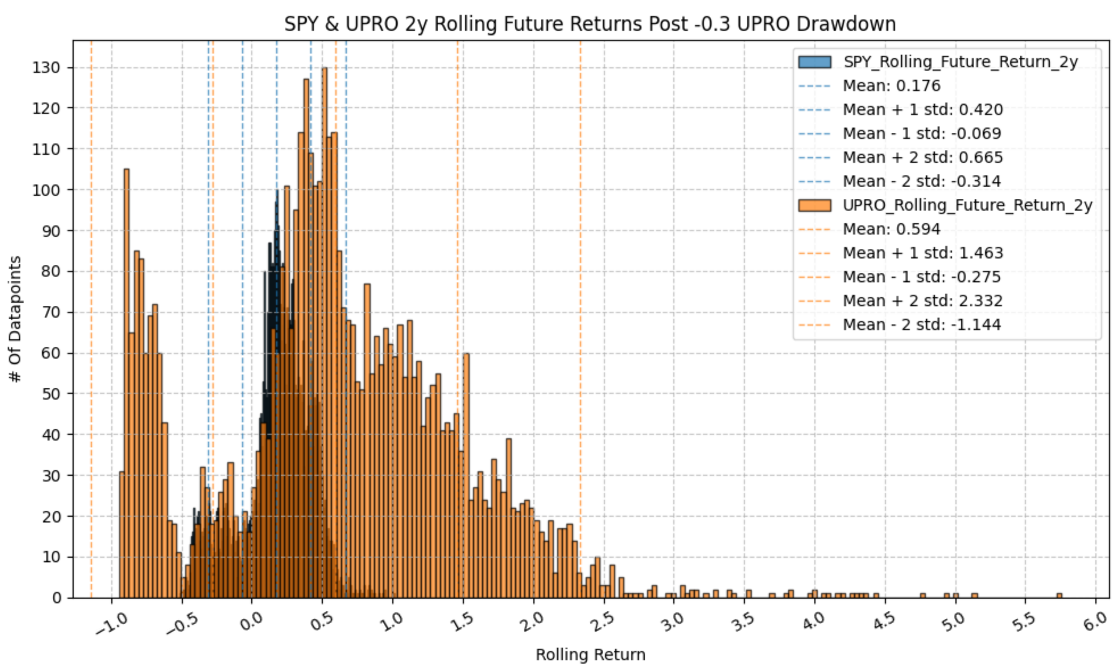
```
0.001       0.005
SPY_Rolling_Future_Return_6m     3.0135      0.009     337.350      0.000
2.996       3.031
==============================================================================
Omnibus:                     1652.367   Durbin-Watson:                   0.081
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            14599.547
Skew:                           1.398   Prob(JB):                         0.00
Kurtosis:                      11.098   Cond. No.                         8.43
==============================================================================

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

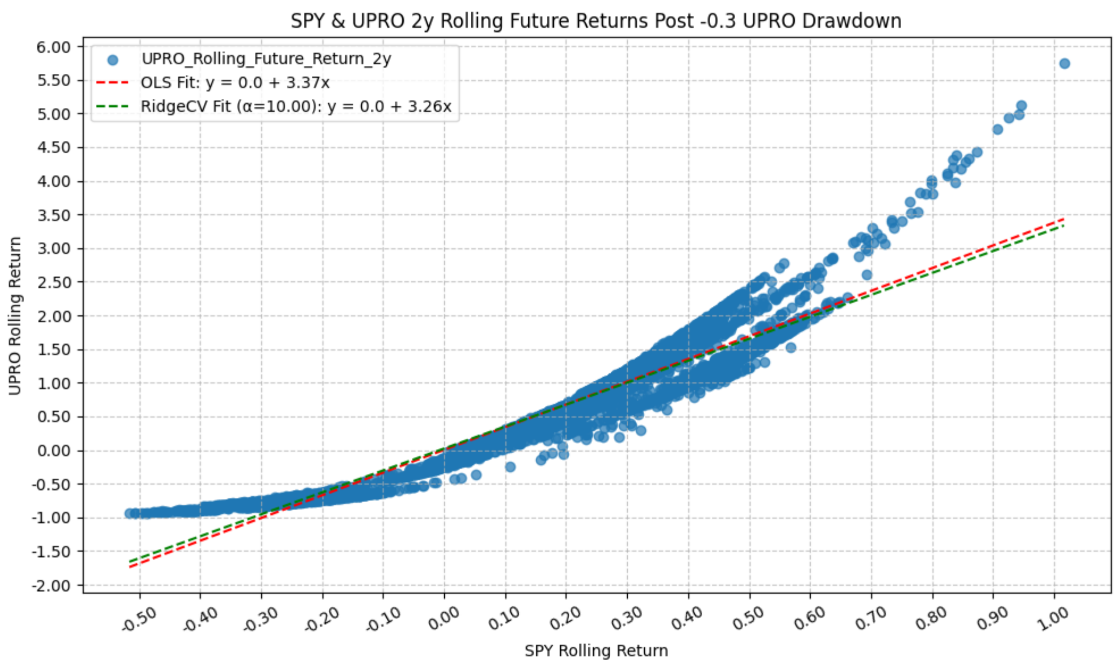





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1y   R-squared:
0.937
Model:                                       OLS   Adj. R-squared:
0.937
Method:                            Least Squares   F-statistic:
7.059e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:37   Log-Likelihood:
2483.5
No. Observations:                           4753   AIC:
-4963.
Df Residuals:                               4751   BIC:
-4950.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                            0.0150      0.002      6.476      0.000
```

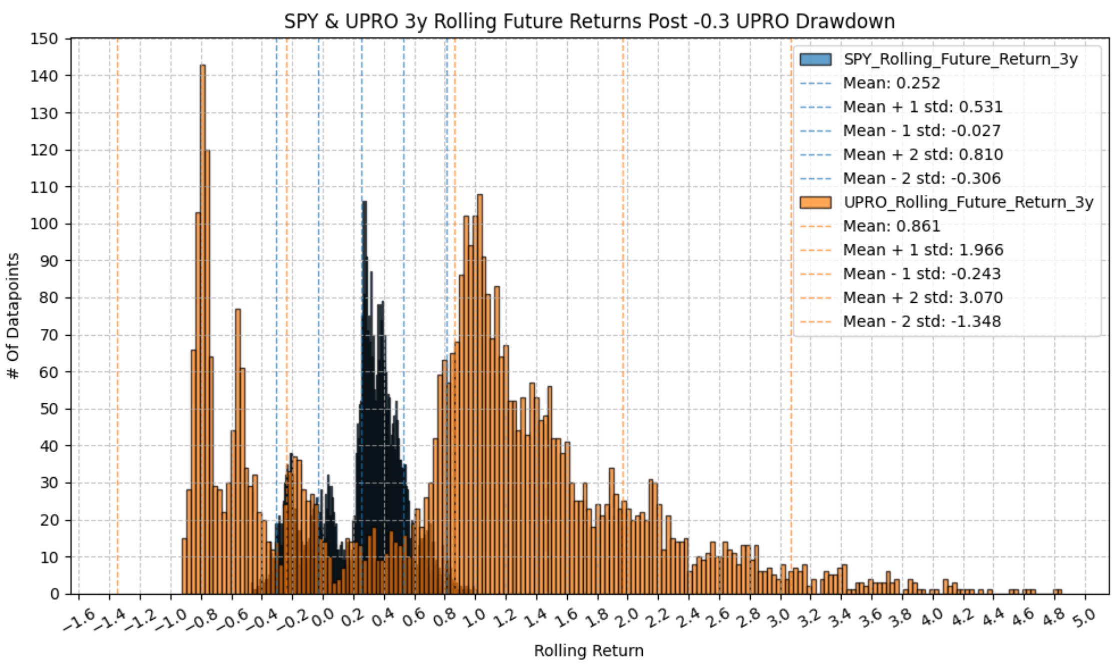
```
0.010      0.020
SPY_Rolling_Future_Return_1y     3.1488      0.012    265.683      0.000
3.126      3.172
==============================================================================
Omnibus:                     1666.063   Durbin-Watson:                   0.054
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            10578.908
Skew:                           1.528   Prob(JB):                         0.00
Kurtosis:                       9.639   Cond. No.                         5.74
==============================================================================

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

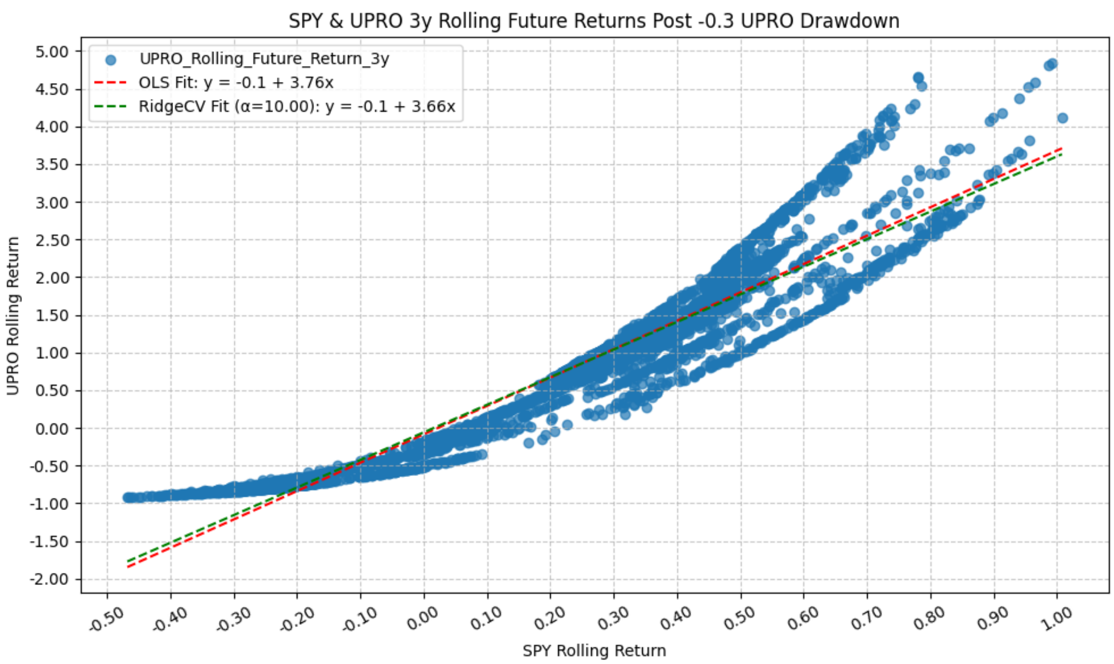





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_2y   R-squared:
0.901
Model:                                       OLS   Adj. R-squared:
0.901
Method:                            Least Squares   F-statistic:
4.347e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:38   Log-Likelihood:
-568.49
No. Observations:                           4753   AIC:
1141.
Df Residuals:                               4751   BIC:
1154.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                            0.0020      0.005      0.409      0.683
```

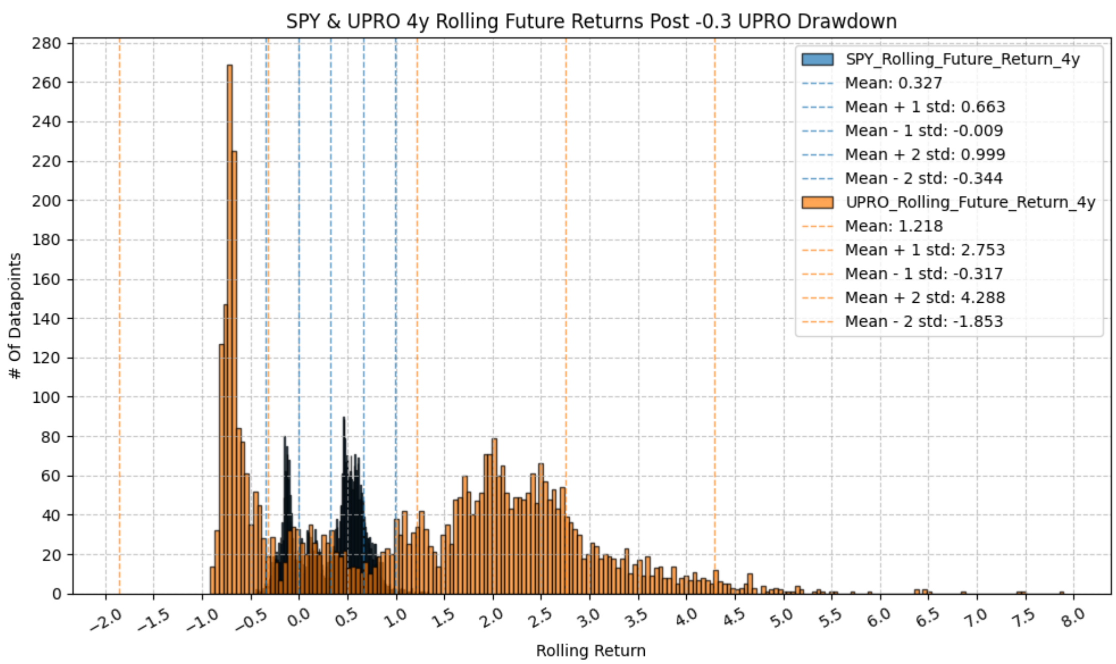
```
-0.008      0.012
SPY_Rolling_Future_Return_2y     3.3736      0.016    208.486      0.000
3.342      3.405
==============================================================================
Omnibus:                     1332.905   Durbin-Watson:                   0.031
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             5113.742
Skew:                           1.349   Prob(JB):                         0.00
Kurtosis:                       7.306   Cond. No.                         4.22
==============================================================================

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

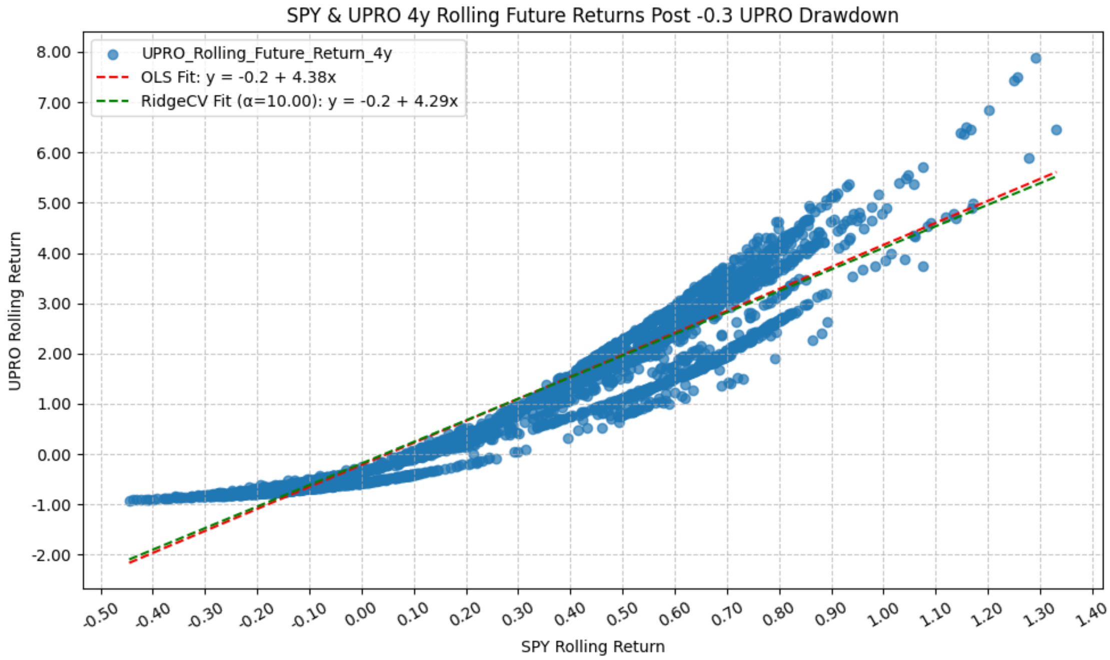





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3y   R-squared:
0.904
Model:                                       OLS   Adj. R-squared:
0.904
Method:                            Least Squares   F-statistic:
4.265e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:39   Log-Likelihood:
-1581.0
No. Observations:                           4545   AIC:
3166.
Df Residuals:                               4543   BIC:
3179.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0865      0.007    -12.630      0.000
```

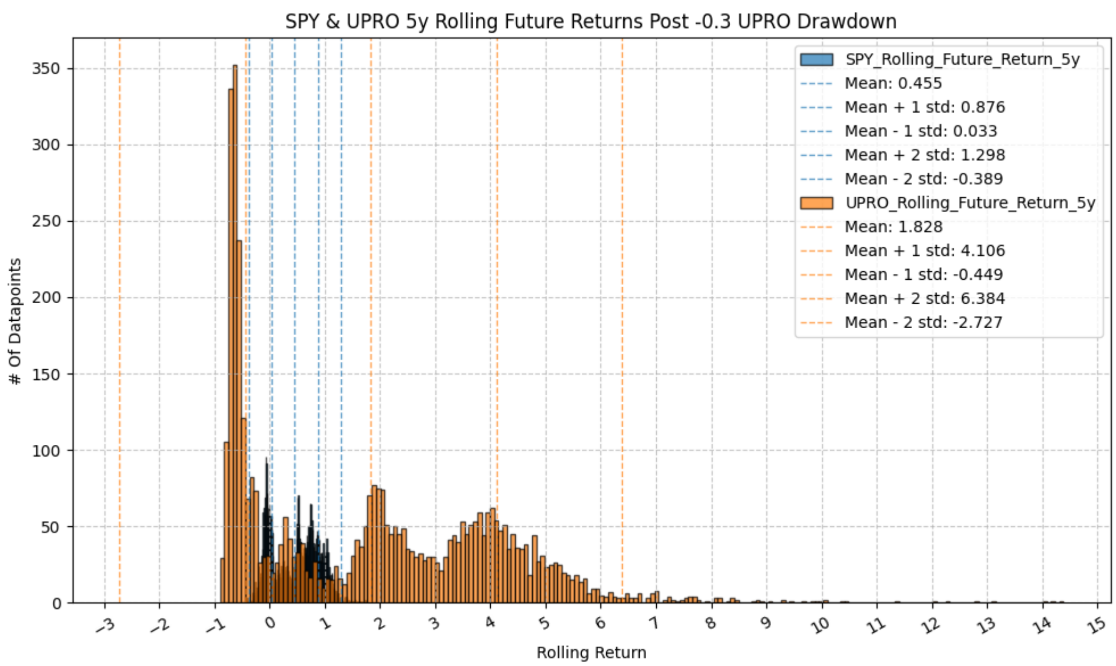
```
-0.100      -0.073
SPY_Rolling_Future_Return_3y     3.7644      0.018    206.520      0.000
3.729       3.800
==============================================================================
Omnibus:                      685.599   Durbin-Watson:                   0.019
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1776.838
Skew:                           0.833   Prob(JB):                         0.00
Kurtosis:                       5.571   Cond. No.                         3.83
==============================================================================

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

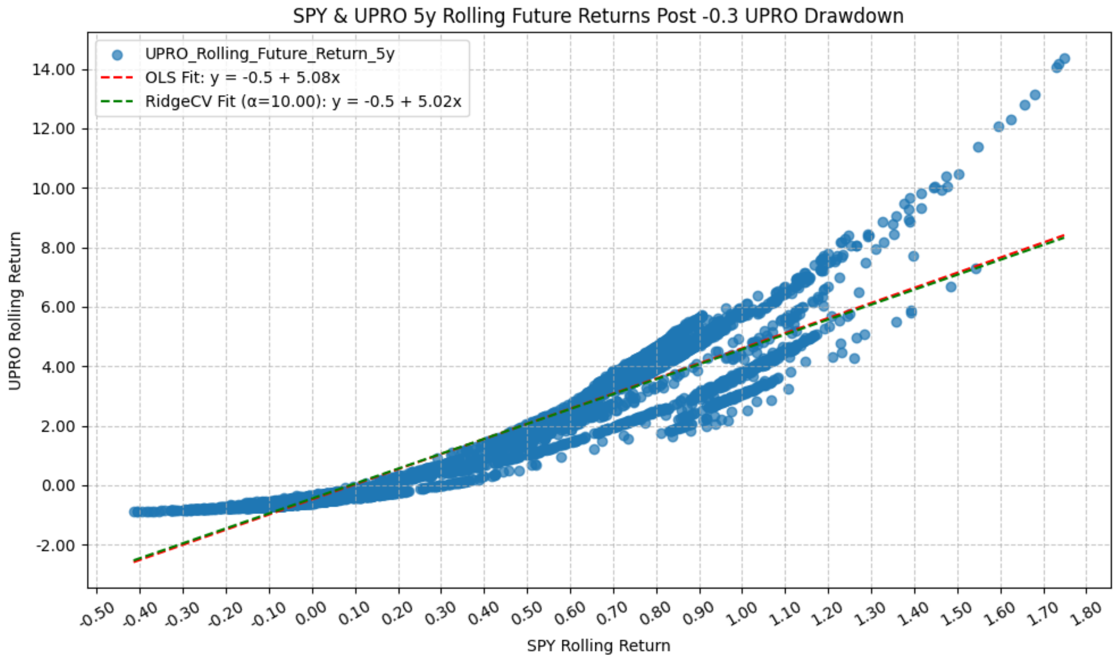





```
                                   OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_4y   R-squared:
0.916
Model:                                       OLS   Adj. R-squared:
0.916
Method:                            Least Squares   F-statistic:
4.728e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:40   Log-Likelihood:
-2622.0
No. Observations:                           4319   AIC:
5248.
Df Residuals:                               4317   BIC:
5261.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.2143      0.009    -22.712      0.000
```

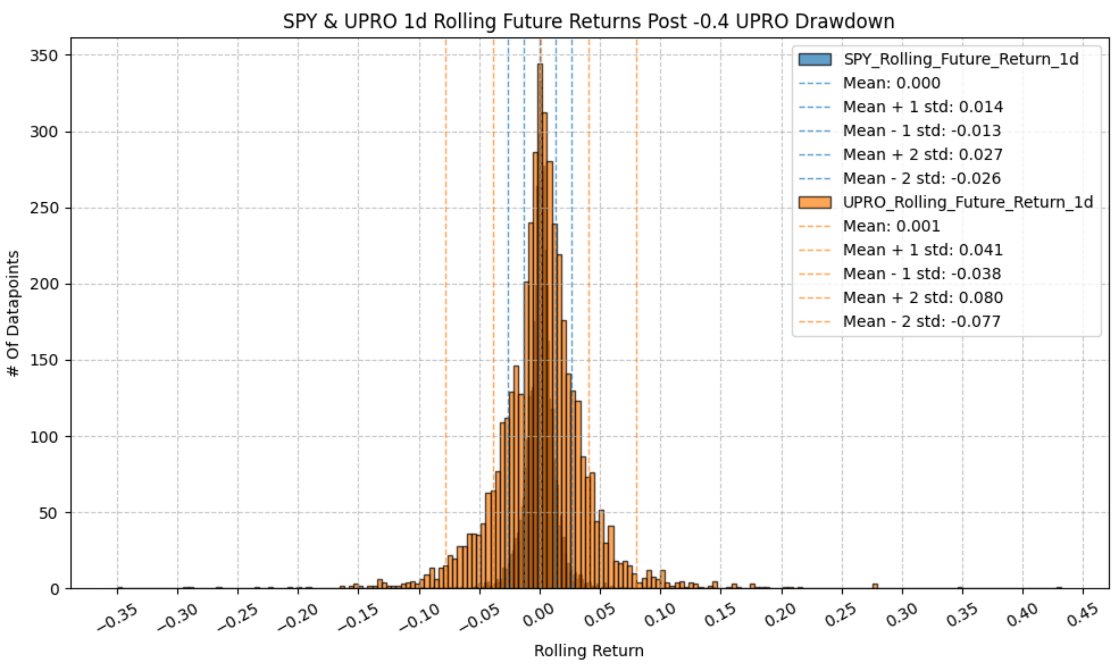
```
-0.233      -0.196
SPY_Rolling_Future_Return_4y     4.3762      0.020    217.433      0.000
4.337       4.416
==============================================================================
Omnibus:                      112.708   Durbin-Watson:                   0.023
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              238.544
Skew:                          -0.138   Prob(JB):                     1.59e-52
Kurtosis:                       4.118   Cond. No.                         3.33
==============================================================================

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

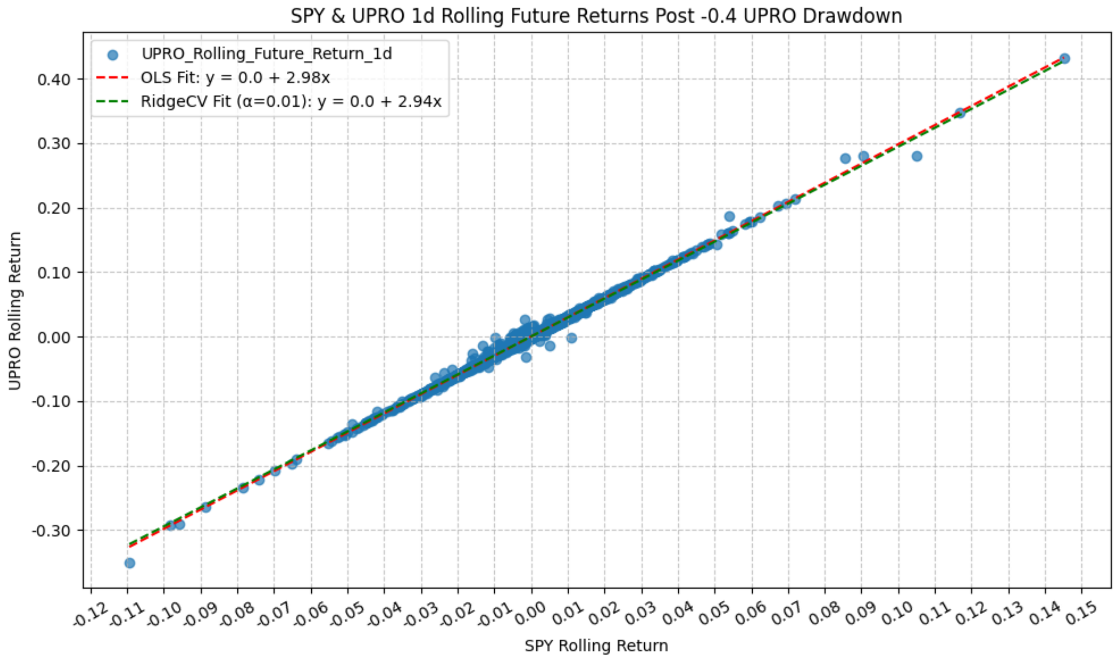





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_5y   R-squared:
0.887
Model:                                       OLS   Adj. R-squared:
0.887
Method:                            Least Squares   F-statistic:
3.391e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:42   Log-Likelihood:
-4969.9
No. Observations:                           4317   AIC:
9944.
Df Residuals:                               4315   BIC:
9957.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.4824      0.017    -28.176      0.000
```

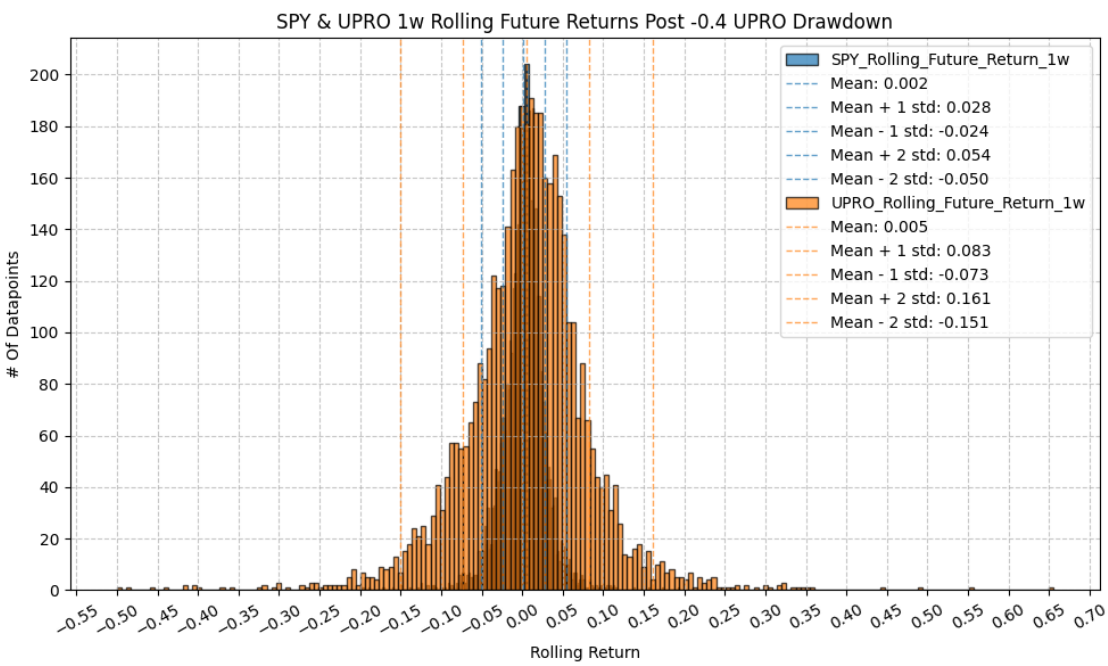
```
-0.516      -0.449
SPY_Rolling_Future_Return_5y     5.0841      0.028    184.147      0.000
5.030       5.138
==============================================================================
Omnibus:                      712.799   Durbin-Watson:                   0.017
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             3463.389
Skew:                           0.712   Prob(JB):                         0.00
Kurtosis:                       7.150   Cond. No.                         2.94
==============================================================================

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

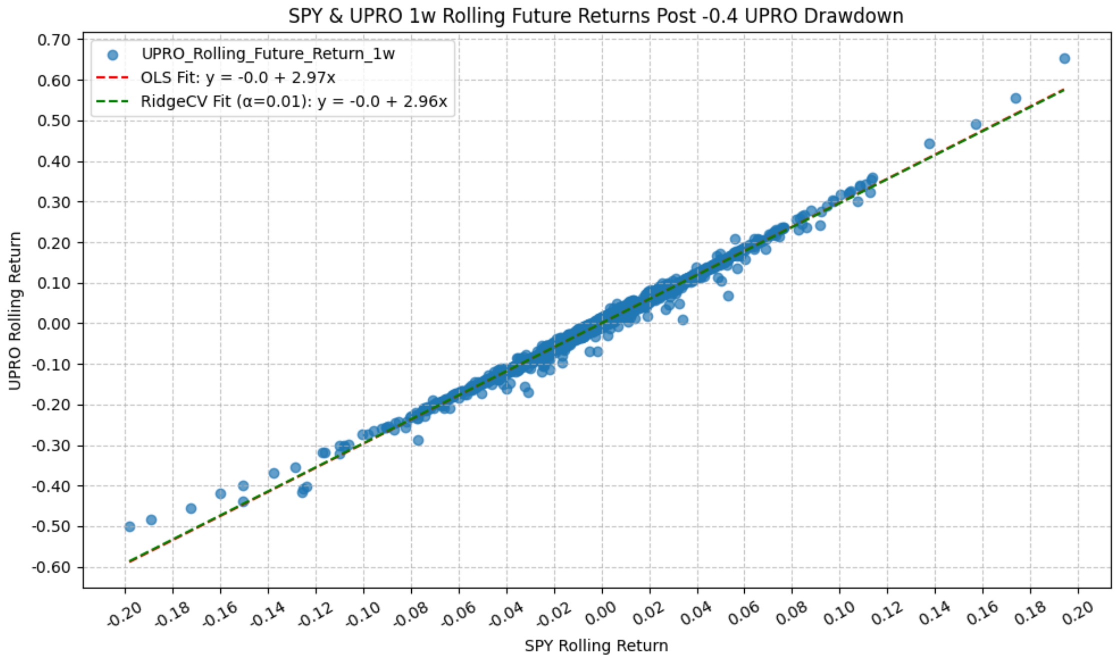





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1d   R-squared:
0.997
Model:                                       OLS   Adj. R-squared:
0.997
Method:                            Least Squares   F-statistic:
1.488e+06
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:43   Log-Likelihood:
21081.
No. Observations:                           4464   AIC:
-4.216e+04
Df Residuals:                               4462   BIC:
-4.214e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                        4.396e-05   3.22e-05      1.364      0.173
```

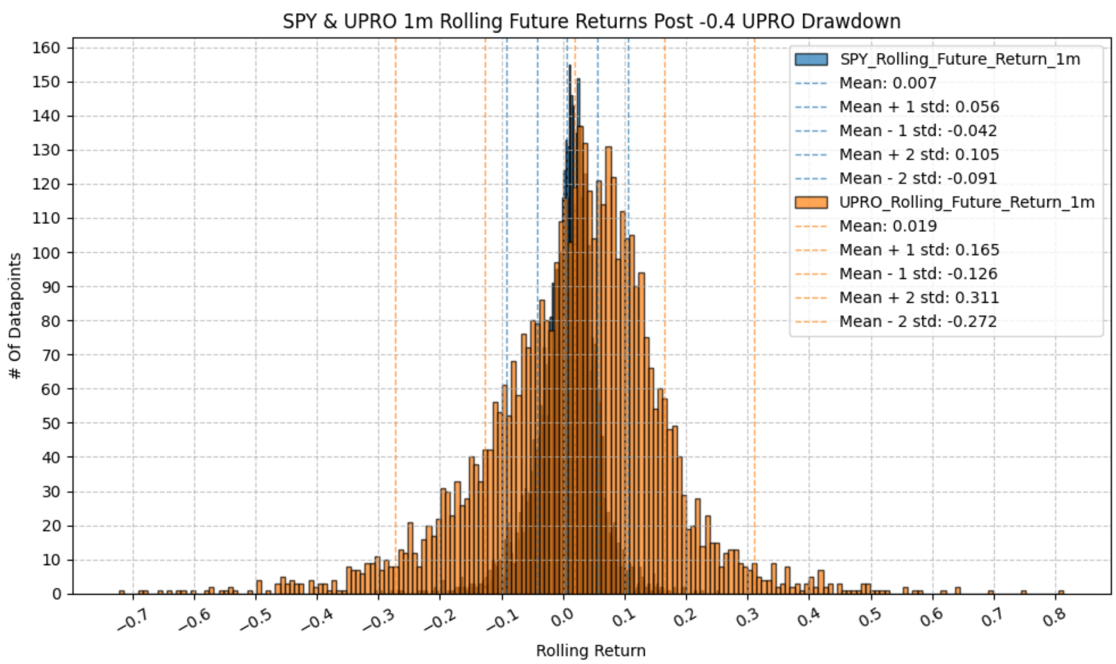
```
-1.92e-05        0.000
SPY_Rolling_Future_Return_1d      2.9793       0.002    1219.664       0.000
2.974       2.984
==============================================================================
Omnibus:                     2686.077   Durbin-Watson:                   2.618
Prob(Omnibus):                  0.000   Jarque-Bera (JB):          1503196.947
Skew:                           1.531   Prob(JB):                         0.00
Kurtosis:                      92.846   Cond. No.                         75.8
==============================================================================

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

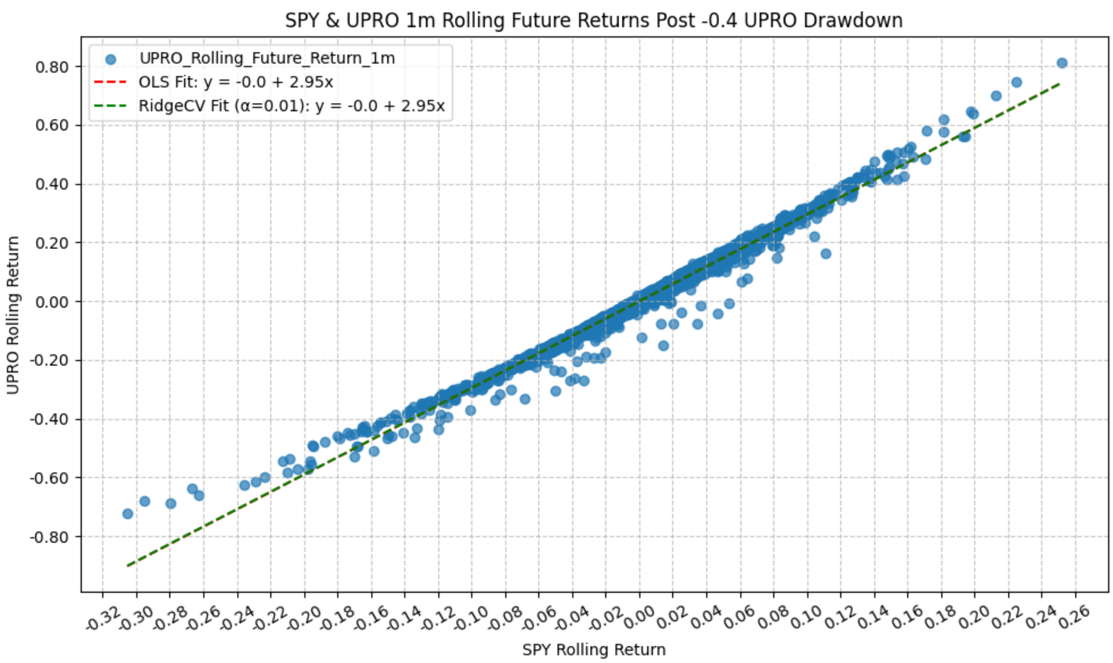





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1w   R-squared:
0.993
Model:                                       OLS   Adj. R-squared:
0.993
Method:                            Least Squares   F-statistic:
6.179e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:44   Log-Likelihood:
16080.
No. Observations:                           4464   AIC:
-3.216e+04
Df Residuals:                               4462   BIC:
-3.214e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.0002    9.9e-05     -1.778      0.075
```

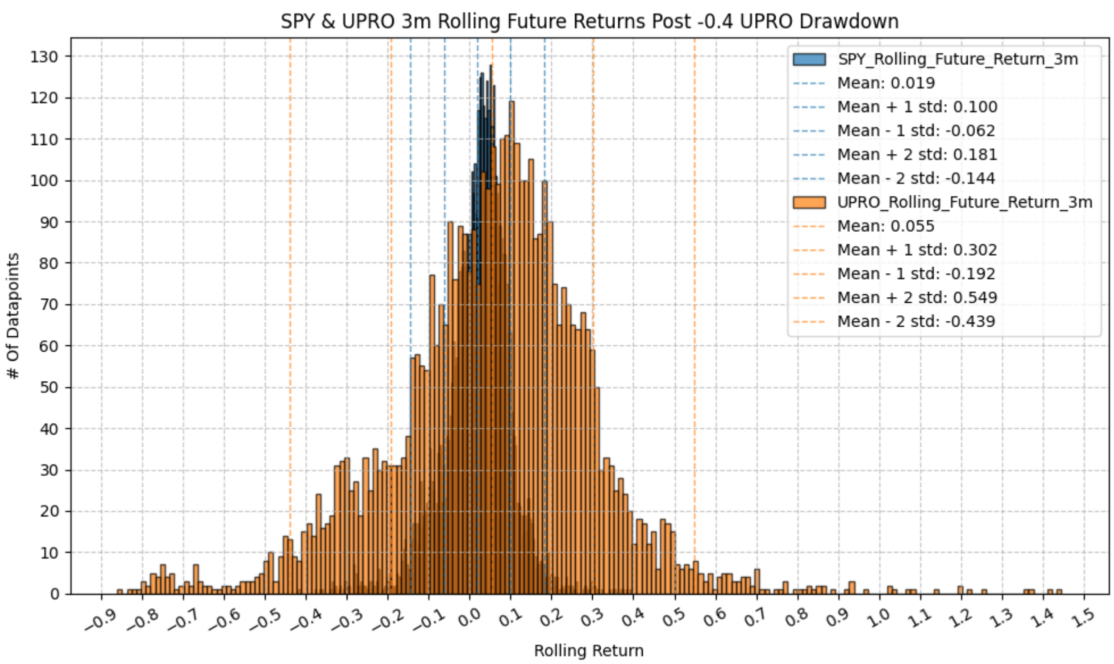
```
-0.000      1.8e-05
SPY_Rolling_Future_Return_1w     2.9718      0.004    786.075      0.000
2.964       2.979
==============================================================================
Omnibus:                     1978.267   Durbin-Watson:                   0.971
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           519572.475
Skew:                          -0.906   Prob(JB):                         0.00
Kurtosis:                      55.822   Cond. No.                         38.3
==============================================================================

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

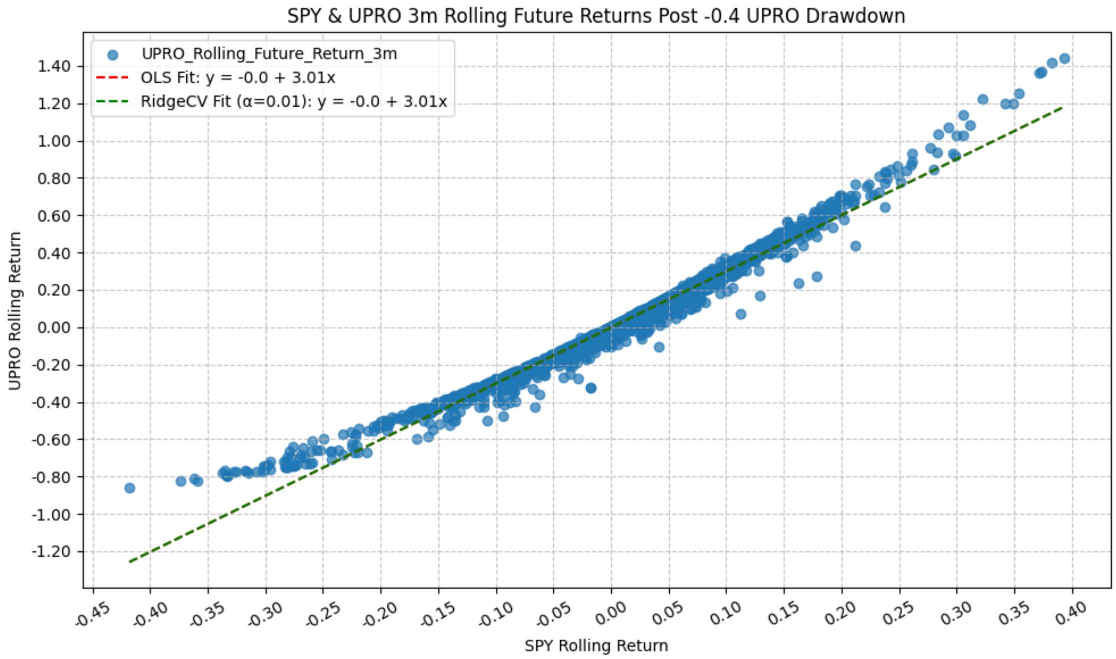





```
                                OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1m   R-squared:
0.986
Model:                                       OLS   Adj. R-squared:
0.986
Method:                            Least Squares   F-statistic:
3.225e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:45   Log-Likelihood:
11851.
No. Observations:                           4464   AIC:
-2.370e+04
Df Residuals:                               4462   BIC:
-2.368e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.0009      0.000     -3.423      0.001
```

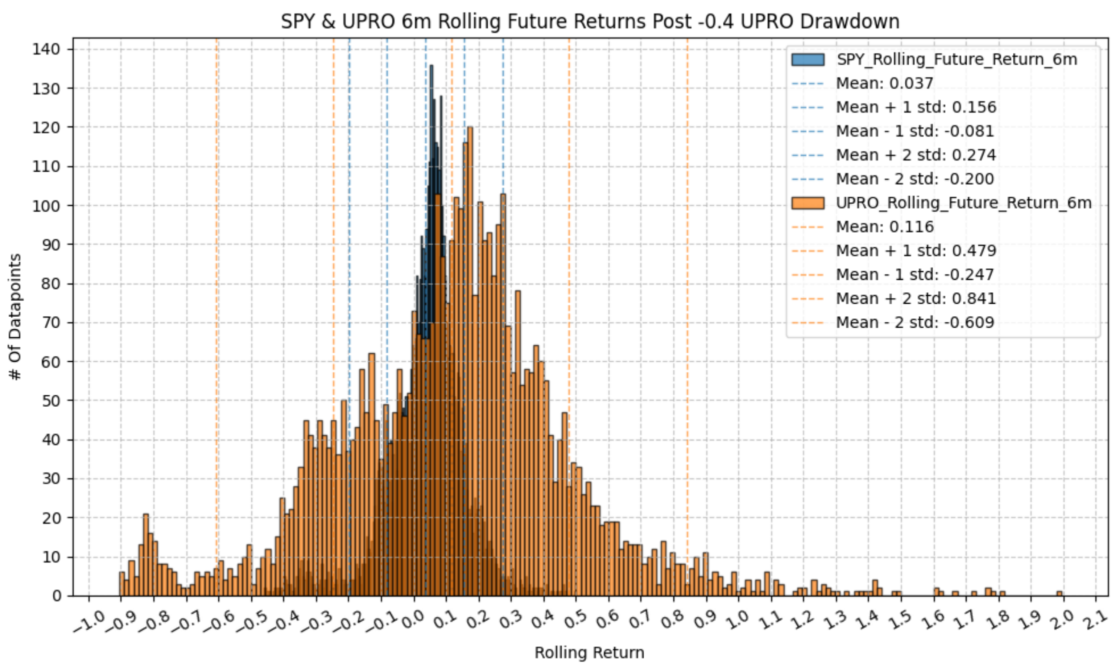
```
-0.001      -0.000
SPY_Rolling_Future_Return_1m     2.9521      0.005     567.899      0.000
2.942       2.962
==============================================================================
Omnibus:                     2550.504   Durbin-Watson:                   0.358
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           256191.593
Skew:                          -1.811   Prob(JB):                         0.00
Kurtosis:                      39.936   Cond. No.                         20.4
==============================================================================

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

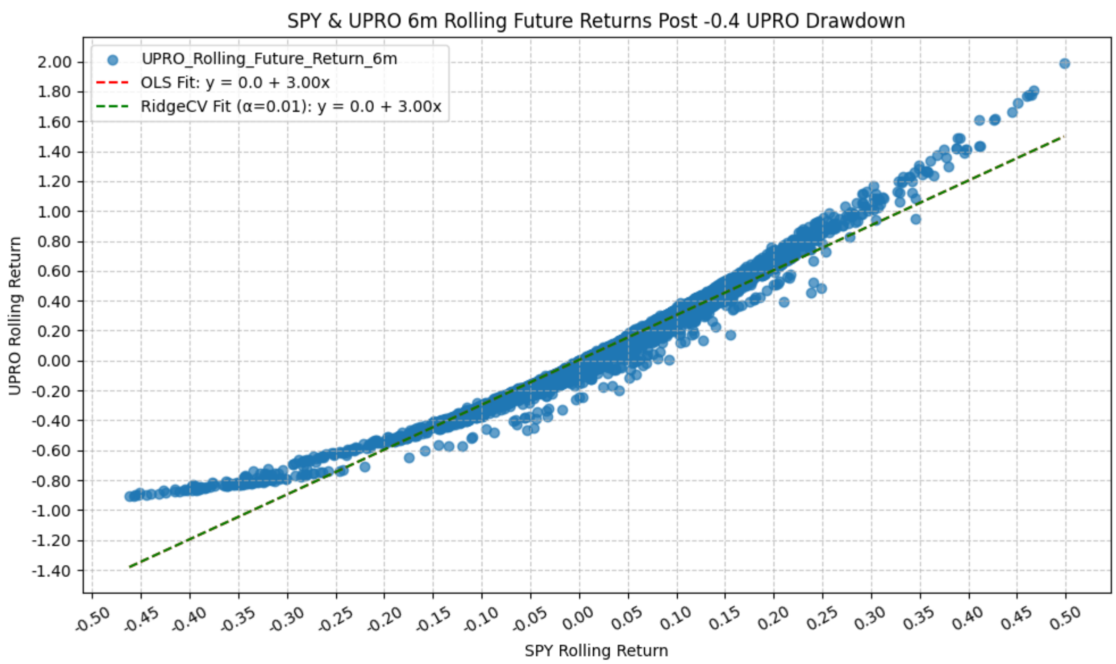





```
                                 OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3m   R-squared:
0.978
Model:                                       OLS   Adj. R-squared:
0.978
Method:                            Least Squares   F-statistic:
2.007e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:46   Log-Likelihood:
8451.5
No. Observations:                           4464   AIC:
-1.690e+04
Df Residuals:                               4462   BIC:
-1.689e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.0018      0.001     -3.149      0.002
```

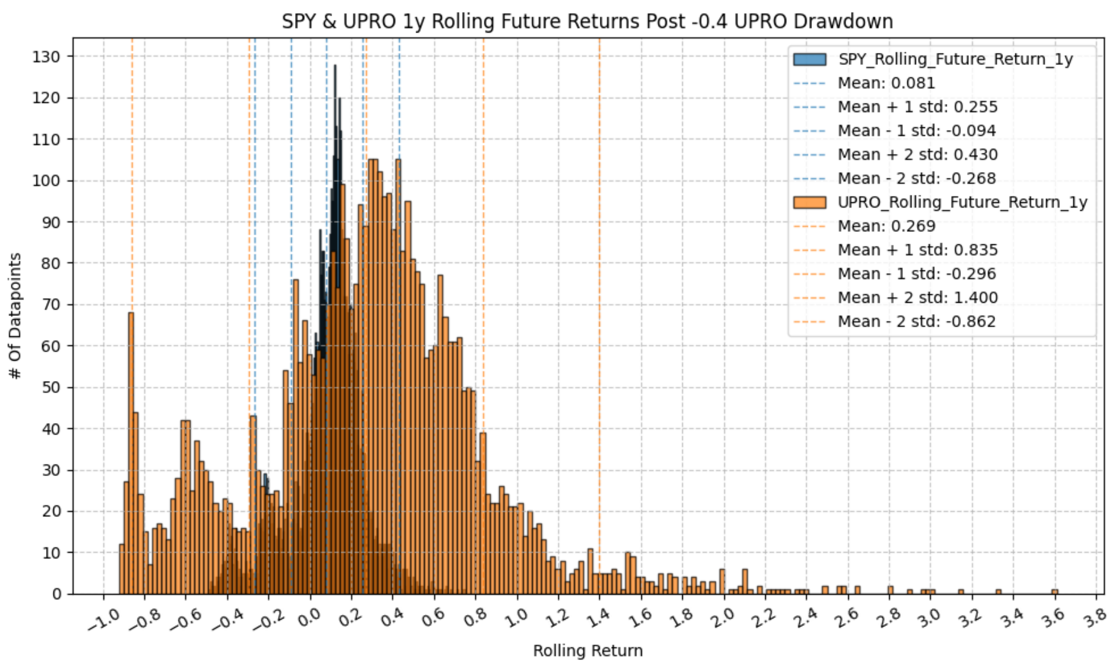
```
-0.003      -0.001
SPY_Rolling_Future_Return_3m     3.0075      0.007     448.019      0.000
2.994       3.021
==============================================================================
Omnibus:                     1648.790   Durbin-Watson:                   0.182
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            57107.468
Skew:                           1.101   Prob(JB):                         0.00
Kurtosis:                      20.383   Cond. No.                         12.3
==============================================================================

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

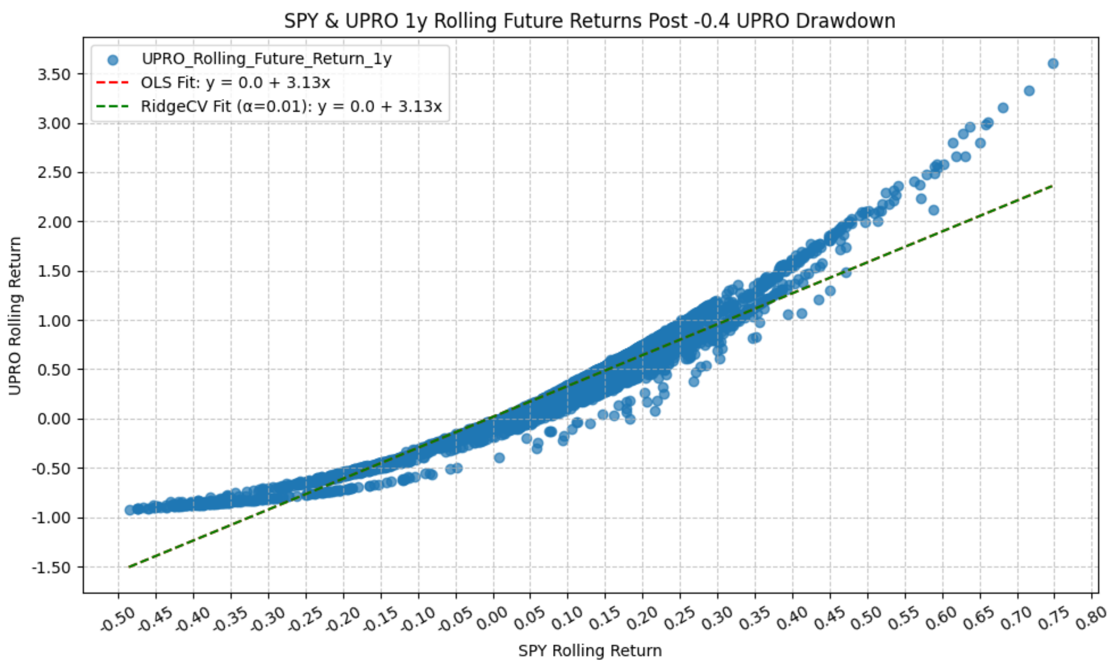





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_6m   R-squared:
0.959
Model:                                       OLS   Adj. R-squared:
0.959
Method:                            Least Squares   F-statistic:
1.039e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:48   Log-Likelihood:
5314.4
No. Observations:                           4464   AIC:
-1.062e+04
Df Residuals:                               4462   BIC:
-1.061e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           0.0040      0.001      3.492      0.000
```

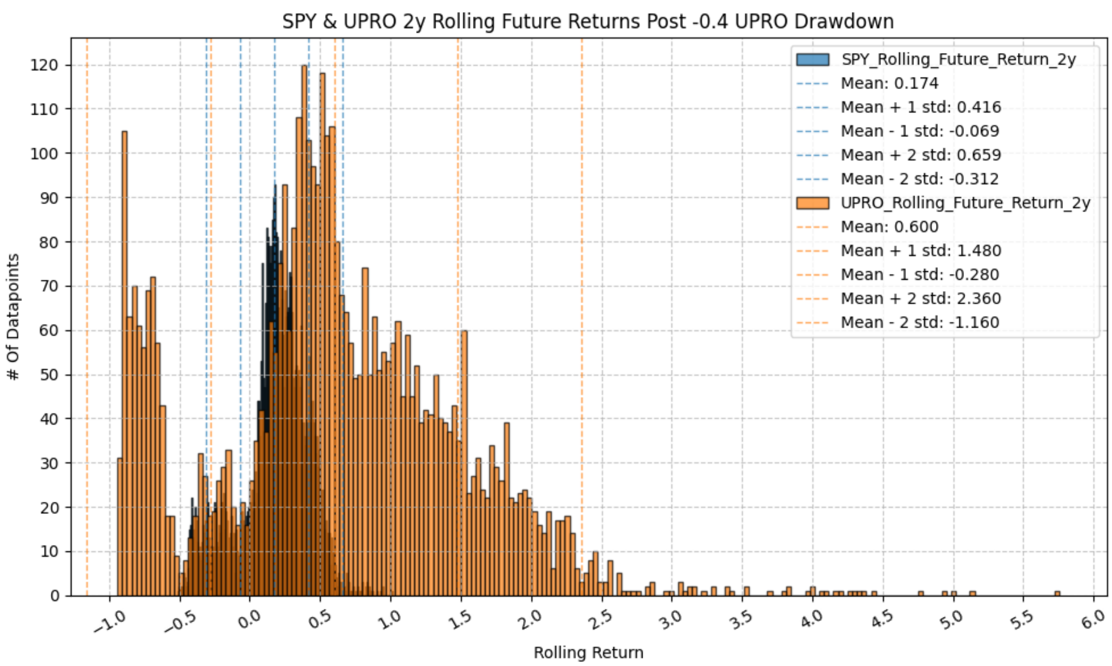
```
0.002       0.006
SPY_Rolling_Future_Return_6m     2.9974      0.009    322.290      0.000
2.979       3.016
==============================================================================
Omnibus:                     1611.795   Durbin-Watson:                   0.081
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            13016.420
Skew:                           1.500   Prob(JB):                         0.00
Kurtosis:                      10.809   Cond. No.                         8.46
==============================================================================

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

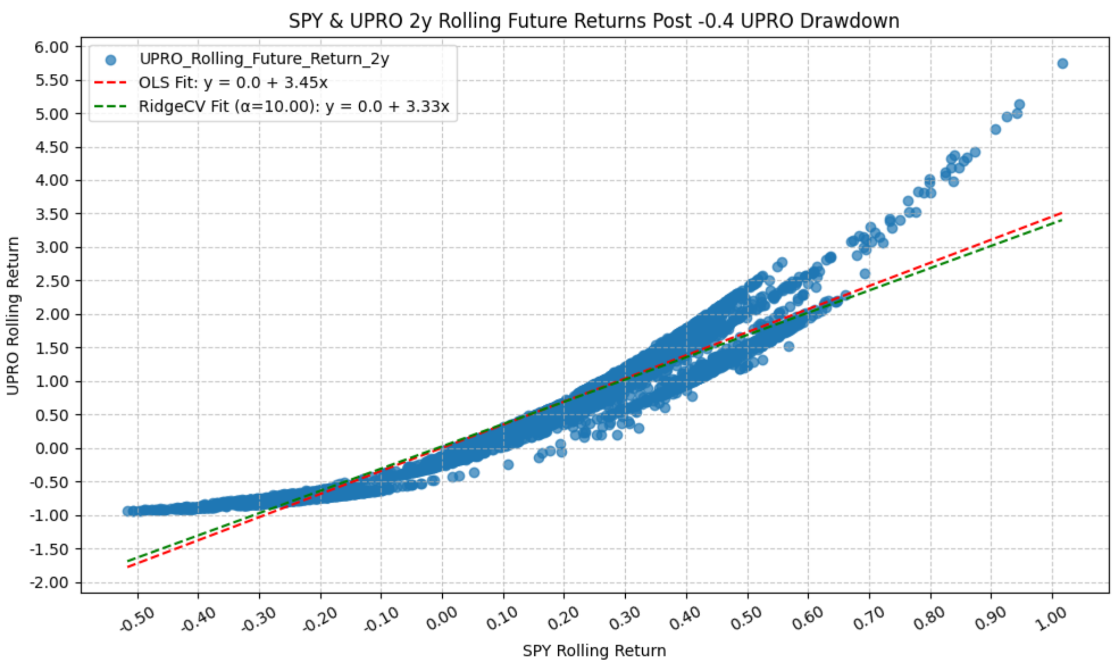





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1y   R-squared:
0.936
Model:                                       OLS   Adj. R-squared:
0.936
Method:                            Least Squares   F-statistic:
6.492e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:49   Log-Likelihood:
2334.7
No. Observations:                           4456   AIC:
-4665.
Df Residuals:                               4454   BIC:
-4653.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                            0.0162      0.002      6.861      0.000
```

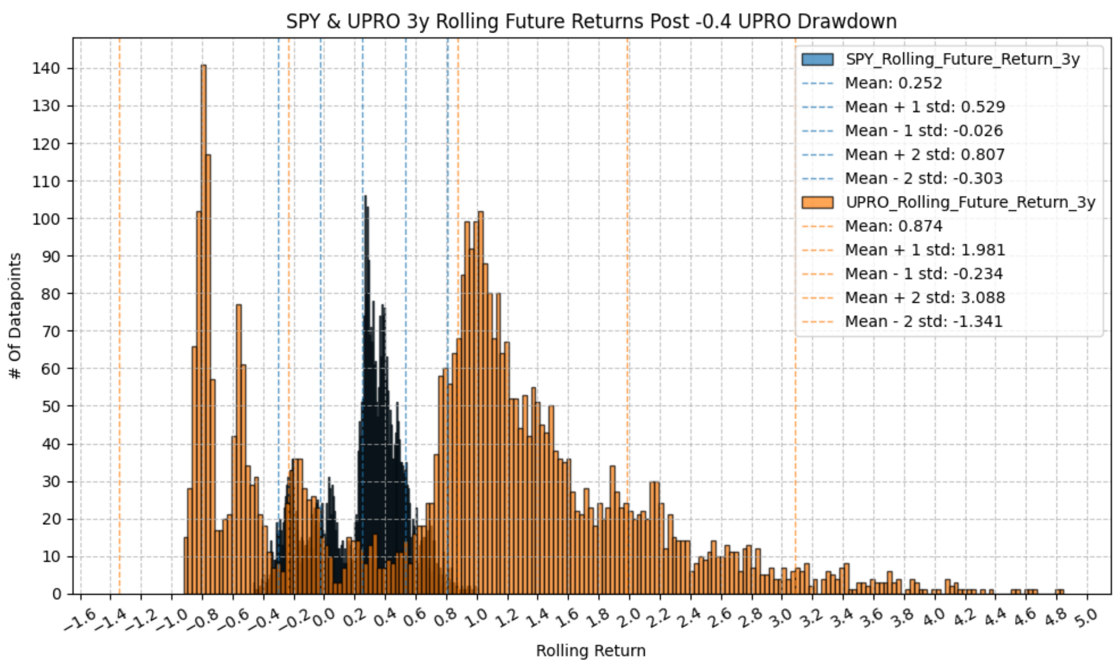
```
0.012        0.021
SPY_Rolling_Future_Return_1y      3.1341       0.012     254.788       0.000
3.110        3.158
==============================================================================
Omnibus:                     1684.542   Durbin-Watson:                   0.054
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            11773.004
Skew:                           1.634   Prob(JB):                         0.00
Kurtosis:                      10.262   Cond. No.                         5.77
==============================================================================

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

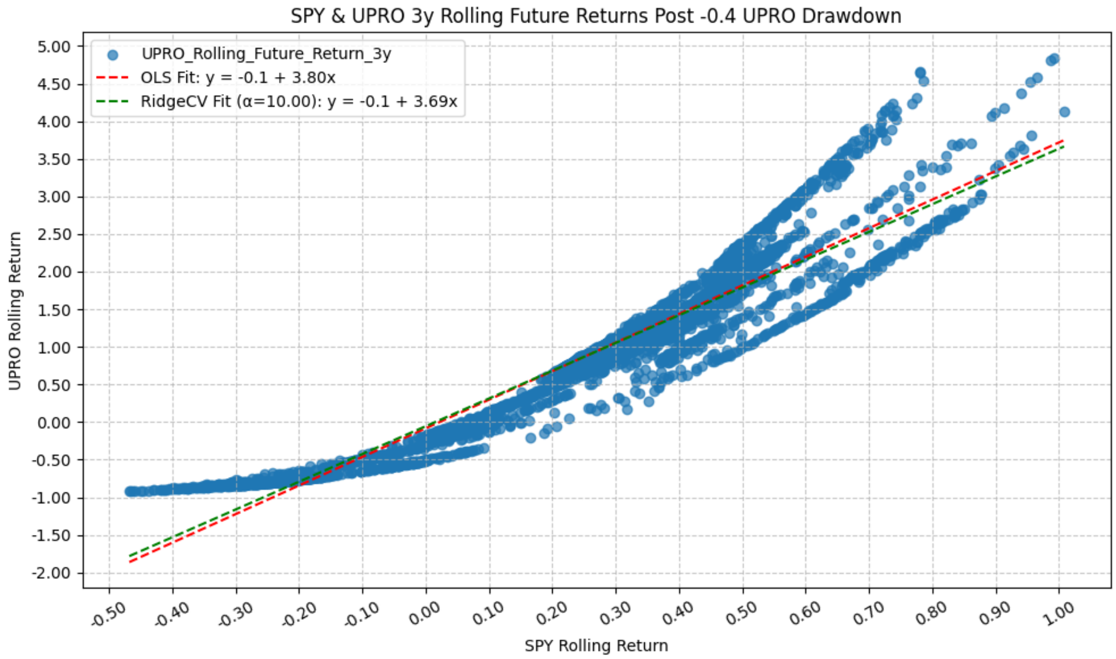





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_2y   R-squared:
0.907
Model:                                       OLS   Adj. R-squared:
0.907
Method:                            Least Squares   F-statistic:
4.354e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:50   Log-Likelihood:
-457.07
No. Observations:                           4456   AIC:
918.1
Df Residuals:                               4454   BIC:
930.9
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           0.0011      0.005      0.221      0.825
```

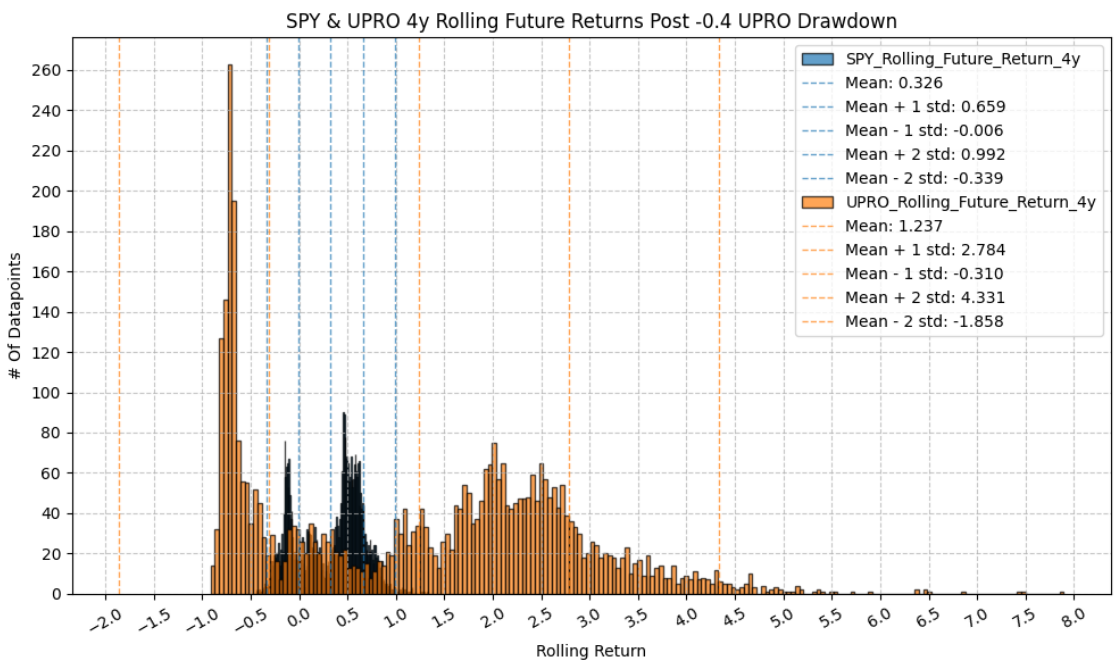
```
-0.009       0.011
SPY_Rolling_Future_Return_2y      3.4517       0.017     208.652       0.000
3.419       3.484
==============================================================================
Omnibus:                     1243.361   Durbin-Watson:                   0.033
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4602.615
Skew:                           1.354   Prob(JB):                         0.00
Kurtosis:                       7.179   Cond. No.                         4.25
==============================================================================

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

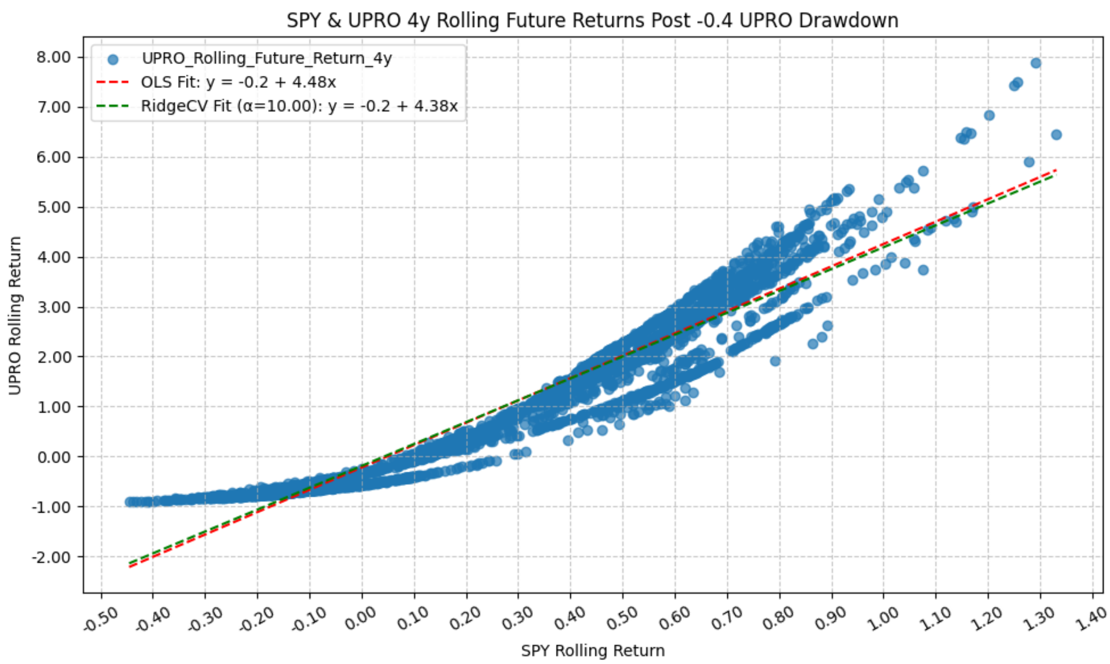





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3y   R-squared:
0.907
Model:                                       OLS   Adj. R-squared:
0.907
Method:                            Least Squares   F-statistic:
4.210e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:51   Log-Likelihood:
-1442.5
No. Observations:                           4323   AIC:
2889.
Df Residuals:                               4321   BIC:
2902.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.0838      0.007    -12.068      0.000
```

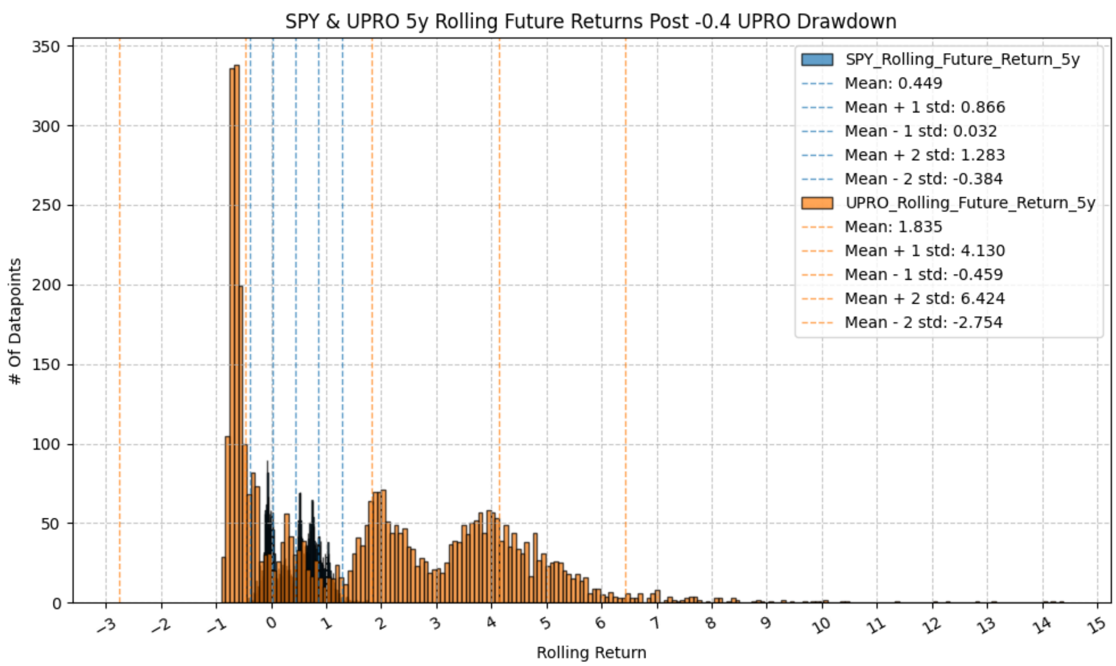
```
-0.097      -0.070
SPY_Rolling_Future_Return_3y     3.8006      0.019    205.187      0.000
3.764       3.837
==============================================================================
Omnibus:                      700.473   Durbin-Watson:                   0.022
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1800.061
Skew:                           0.891   Prob(JB):                         0.00
Kurtosis:                       5.611   Cond. No.                         3.85
==============================================================================

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

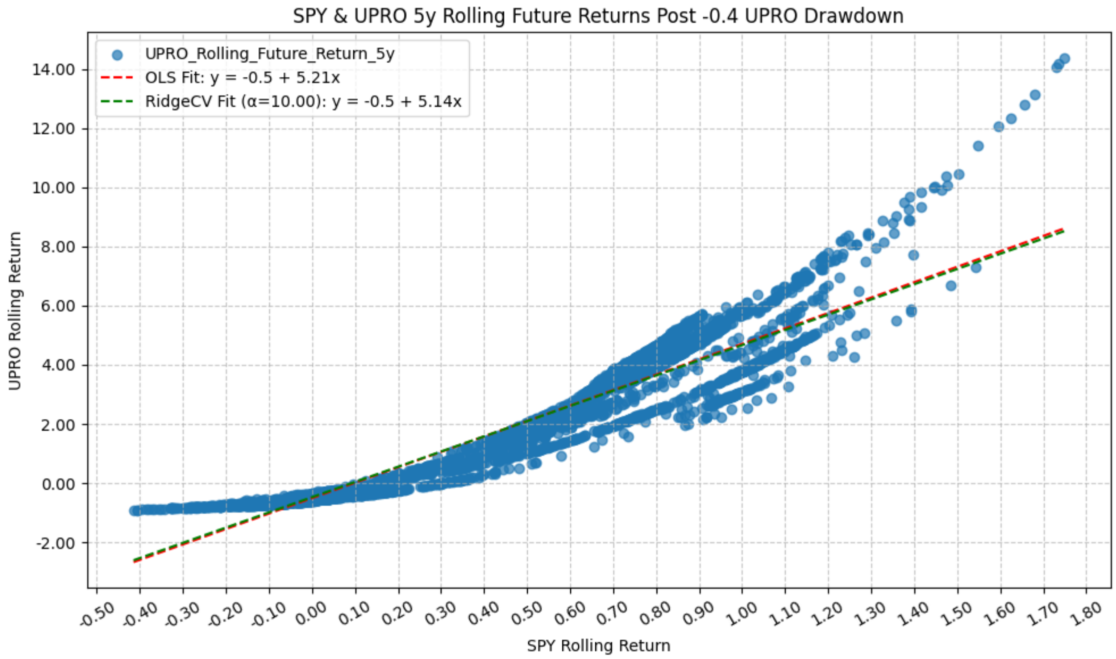





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_4y   R-squared:
0.926
Model:                                       OLS   Adj. R-squared:
0.926
Method:                            Least Squares   F-statistic:
5.187e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:52   Log-Likelihood:
-2273.5
No. Observations:                           4126   AIC:
4551.
Df Residuals:                               4124   BIC:
4564.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.2233      0.009    -24.385      0.000
```

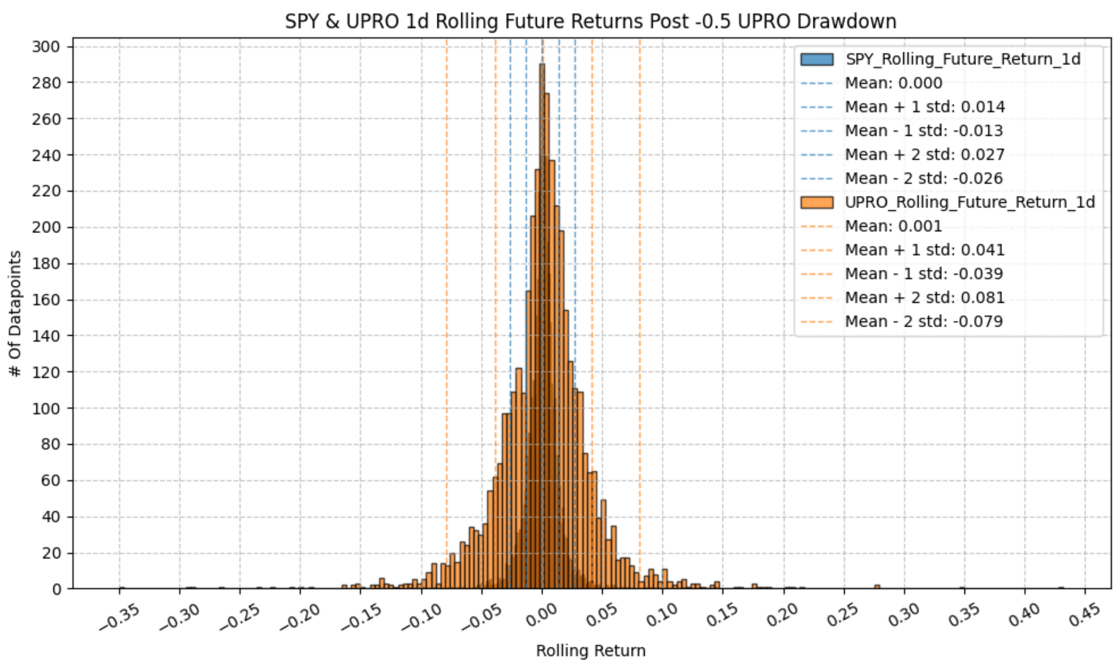
```
-0.241      -0.205
SPY_Rolling_Future_Return_4y     4.4751      0.020    227.751      0.000
4.437       4.514
==============================================================================
Omnibus:                      119.525   Durbin-Watson:                   0.024
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              294.806
Skew:                          -0.074   Prob(JB):                     9.63e-65
Kurtosis:                       4.301   Cond. No.                         3.36
==============================================================================

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

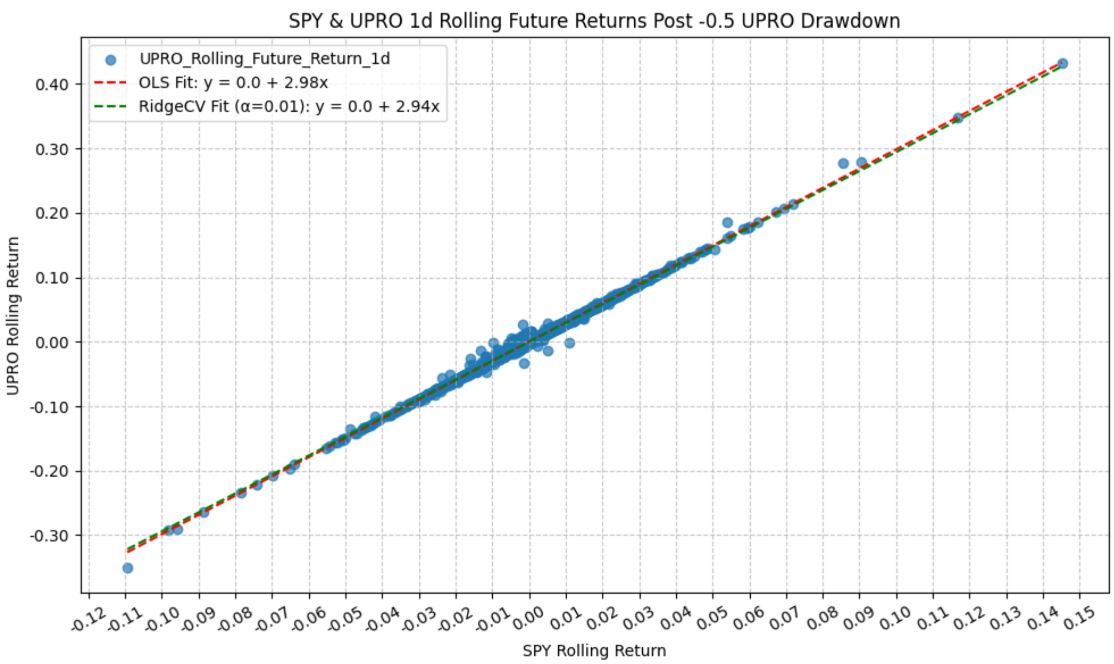





```
                                OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_5y   R-squared:
0.896
Model:                                       OLS   Adj. R-squared:
0.896
Method:                            Least Squares   F-statistic:
3.555e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:54   Log-Likelihood:
-4610.6
No. Observations:                           4126   AIC:
9225.
Df Residuals:                               4124   BIC:
9238.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                          -0.5058      0.017    -29.867      0.000
```

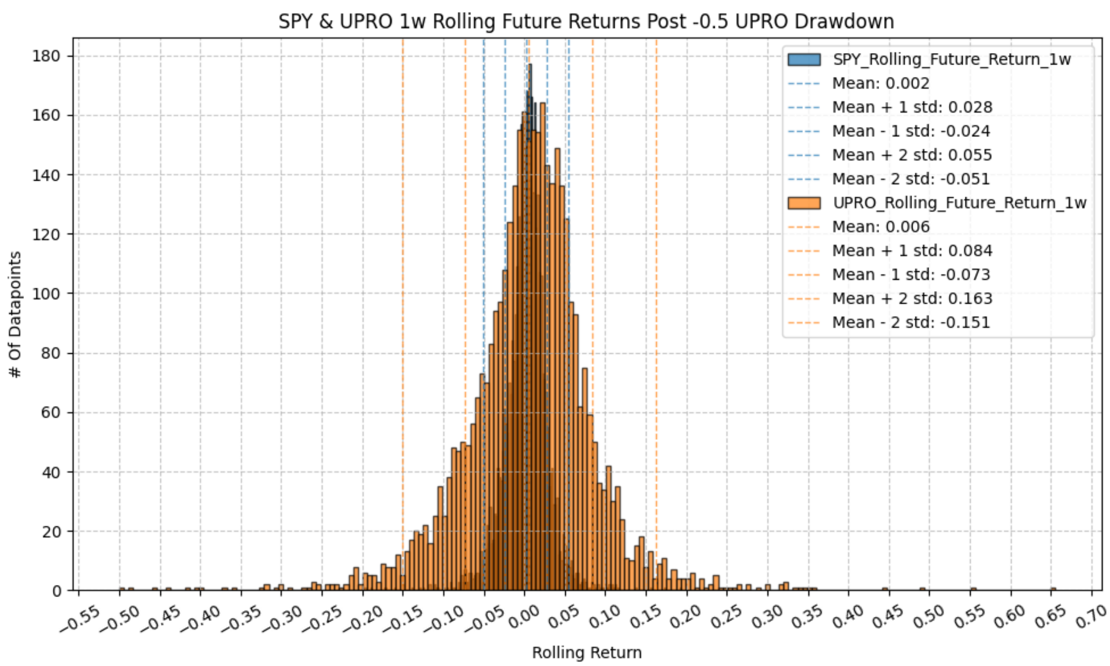
```
-0.539      -0.473
SPY_Rolling_Future_Return_5y     5.2122      0.028    188.534      0.000
5.158       5.266
==============================================================================
Omnibus:                      688.588   Durbin-Watson:                   0.019
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             3306.754
Skew:                           0.724   Prob(JB):                         0.00
Kurtosis:                       7.140   Cond. No.                         2.96
==============================================================================

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

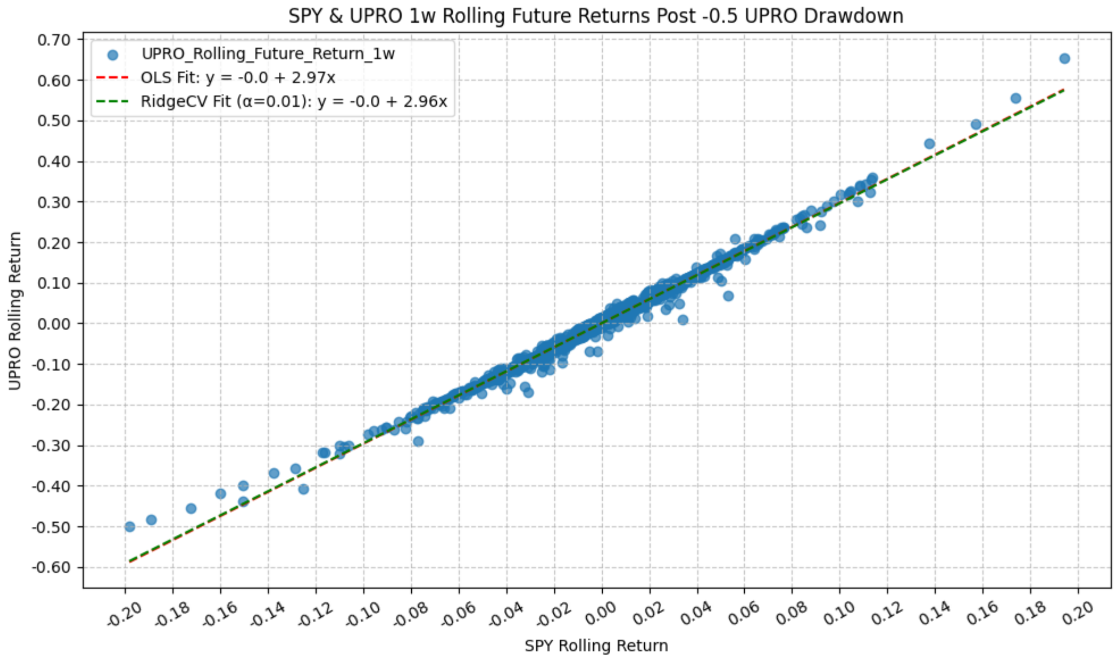





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1d   R-squared:
0.997
Model:                                       OLS   Adj. R-squared:
0.997
Method:                            Least Squares   F-statistic:
1.317e+06
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:55   Log-Likelihood:
18256.
No. Observations:                           3871   AIC:
-3.651e+04
Df Residuals:                               3869   BIC:
-3.650e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         6.221e-05   3.48e-05      1.786      0.074
```

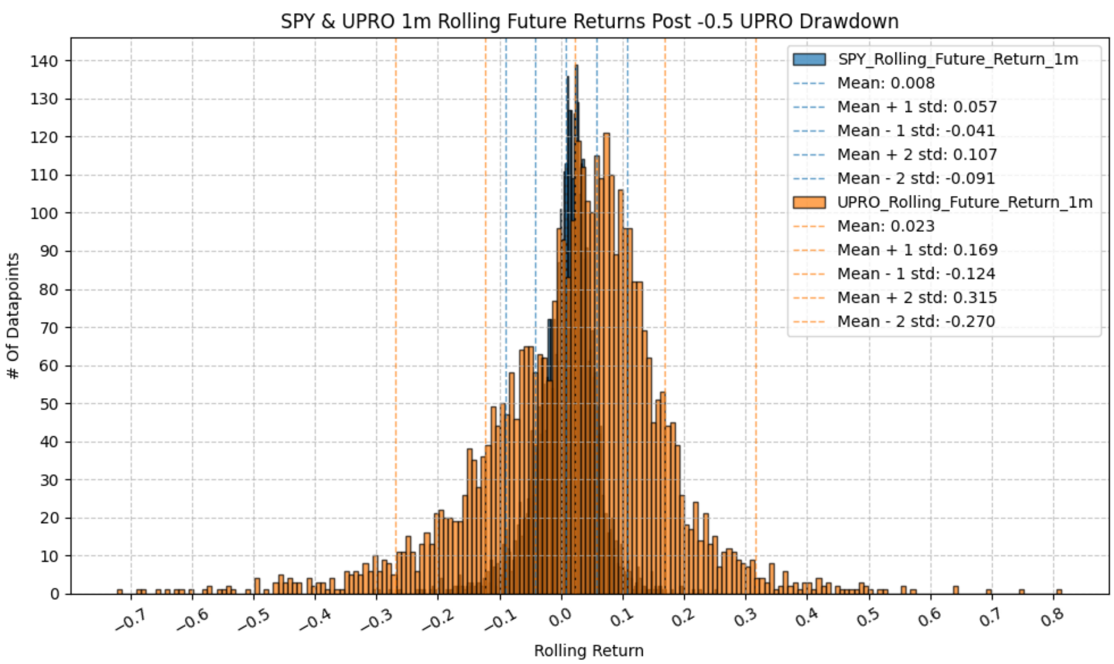
```
-6.08e-06        0.000
SPY_Rolling_Future_Return_1d      2.9842       0.003    1147.793       0.000
2.979       2.989
==============================================================================
Omnibus:                     2862.865   Durbin-Watson:                   2.686
Prob(Omnibus):                  0.000   Jarque-Bera (JB):          1149210.351
Skew:                           2.367   Prob(JB):                         0.00
Kurtosis:                      87.277   Cond. No.                         74.7
==============================================================================

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

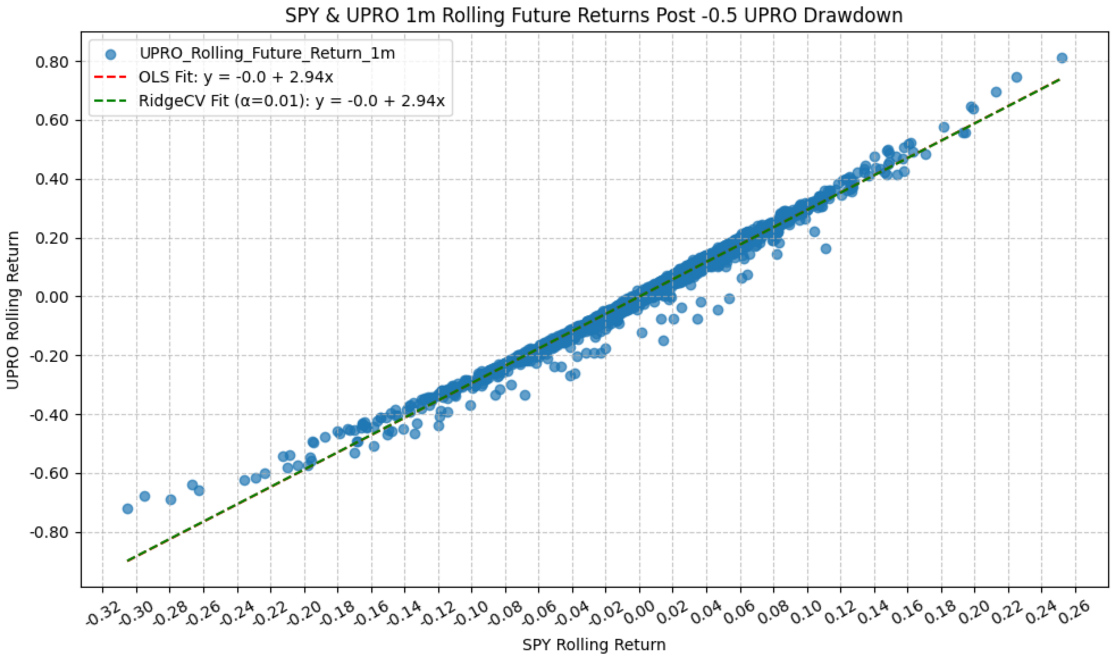





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1w   R-squared:
0.992
Model:                                       OLS   Adj. R-squared:
0.992
Method:                            Least Squares   F-statistic:
5.116e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:56   Log-Likelihood:
13825.
No. Observations:                           3871   AIC:
-2.765e+04
Df Residuals:                               3869   BIC:
-2.763e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                          -0.0001      0.000     -0.958      0.338
```

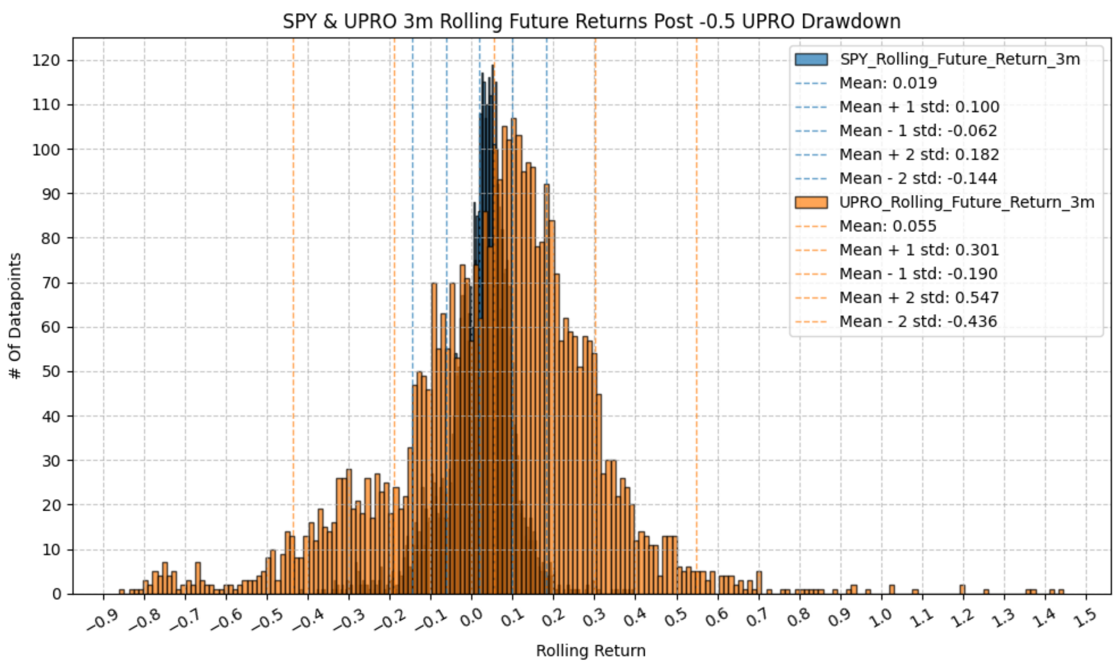
```
-0.000      0.000
SPY_Rolling_Future_Return_1w     2.9704      0.004    715.239      0.000
2.962      2.979
==============================================================================
Omnibus:                     1716.538   Durbin-Watson:                   1.002
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           449887.905
Skew:                          -0.903   Prob(JB):                         0.00
Kurtosis:                      55.783   Cond. No.                         38.0
==============================================================================

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

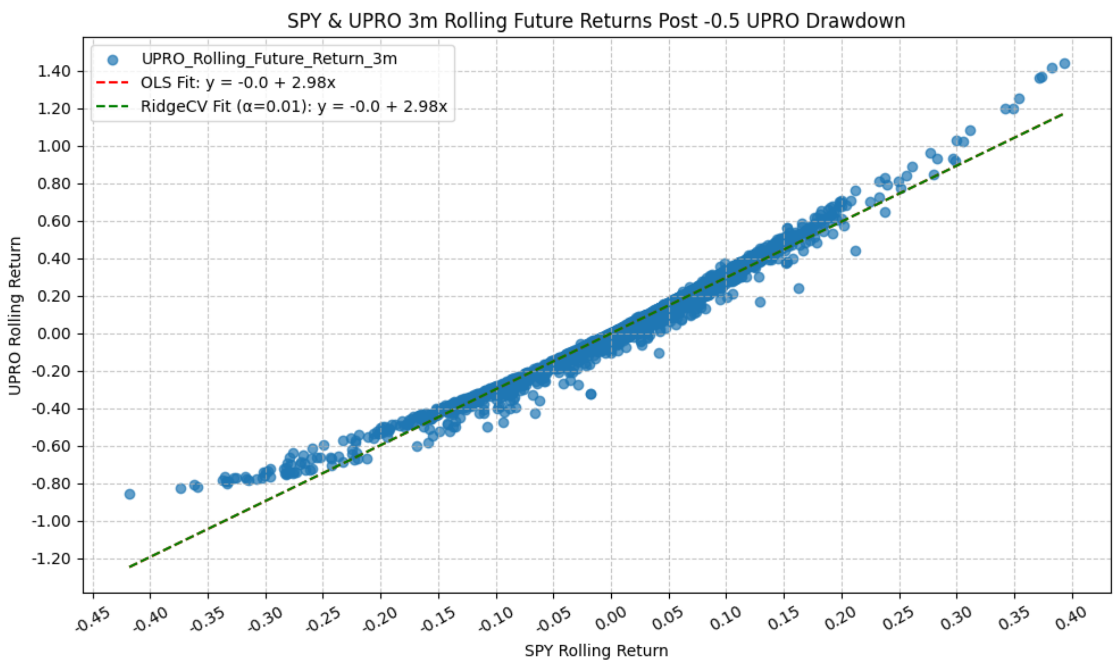





```
                              OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1m   R-squared:
0.986
Model:                                       OLS   Adj. R-squared:
0.986
Method:                            Least Squares   F-statistic:
2.738e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:57   Log-Likelihood:
10219.
No. Observations:                           3871   AIC:
-2.043e+04
Df Residuals:                               3869   BIC:
-2.042e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                         -0.0008      0.000     -2.717      0.007
```

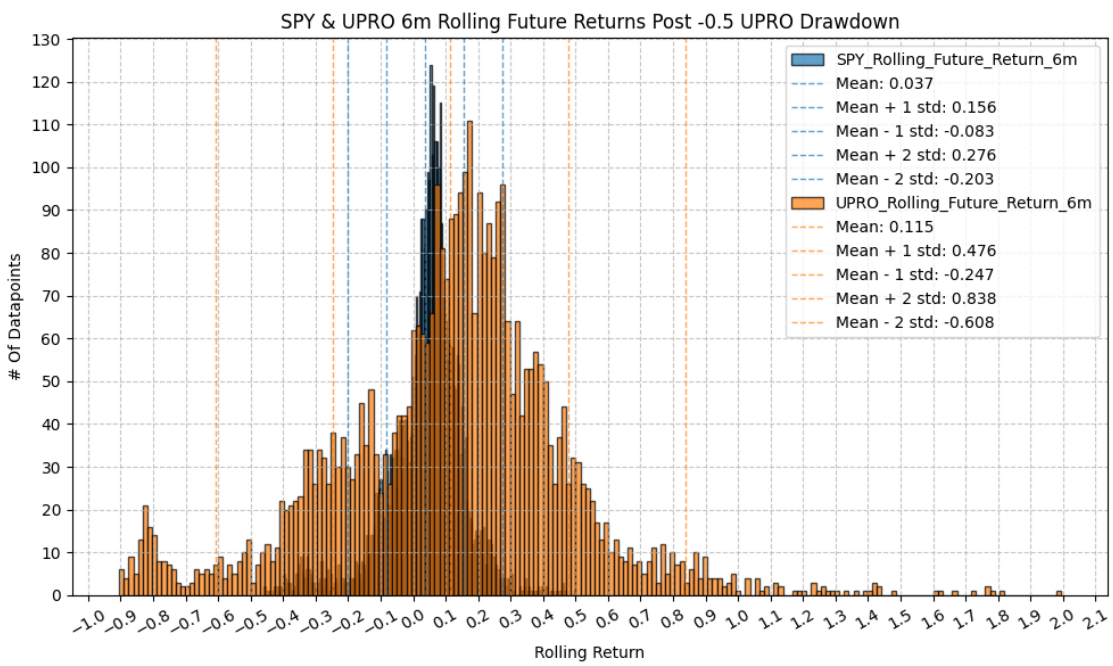
```
-0.001      -0.000
SPY_Rolling_Future_Return_1m     2.9439      0.006     523.305      0.000
2.933       2.955
==============================================================================
Omnibus:                     2107.631   Durbin-Watson:                   0.385
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           199364.230
Skew:                          -1.681   Prob(JB):                         0.00
Kurtosis:                      37.996   Cond. No.                         20.3
==============================================================================

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

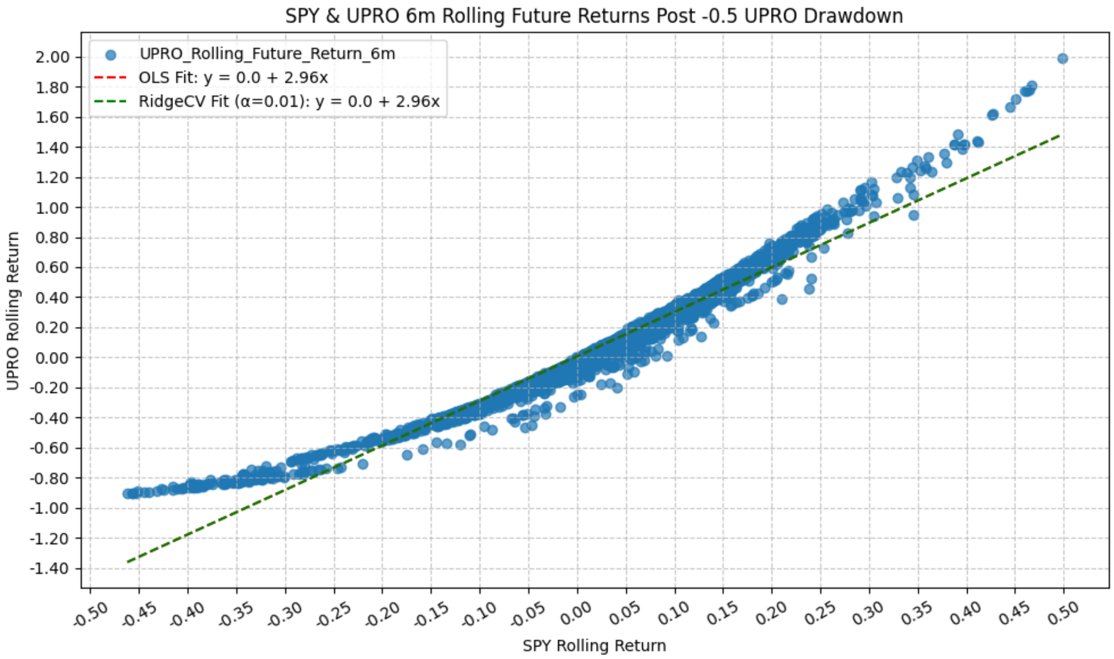





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3m   R-squared:
0.978
Model:                                       OLS   Adj. R-squared:
0.978
Method:                            Least Squares   F-statistic:
1.701e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:28:58   Log-Likelihood:
7306.6
No. Observations:                           3871   AIC:
-1.461e+04
Df Residuals:                               3869   BIC:
-1.460e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                          -0.0011      0.001     -1.901      0.057
```

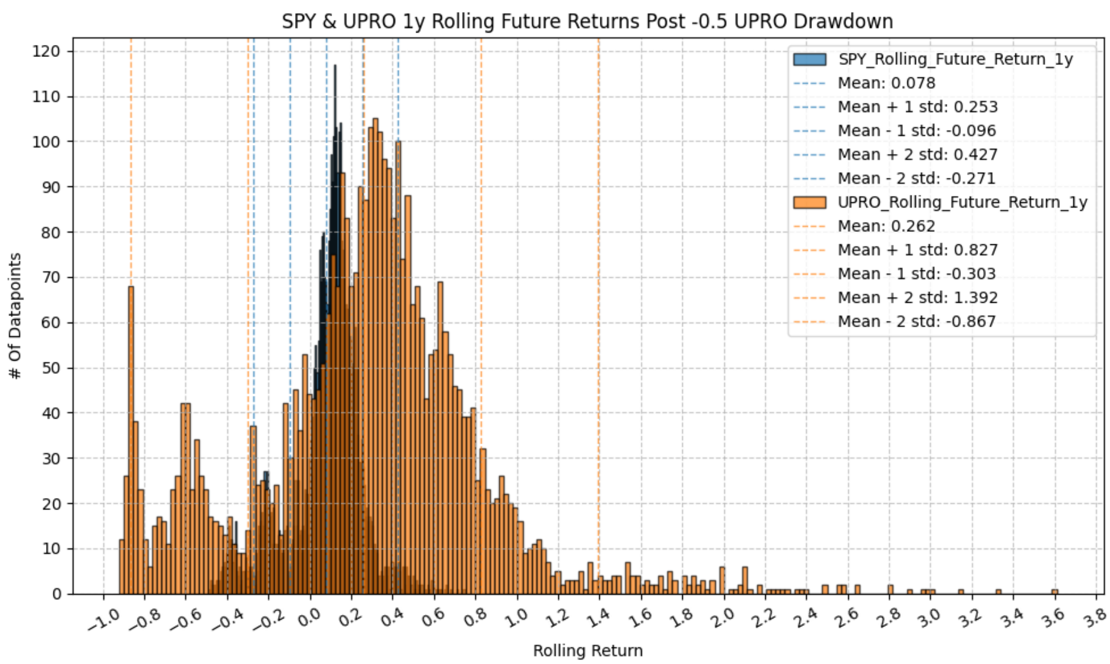
```
-0.002    3.63e-05
SPY_Rolling_Future_Return_3m     2.9840      0.007    412.439      0.000
2.970      2.998
==============================================================================
Omnibus:                     1375.125   Durbin-Watson:                   0.193
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            43082.229
Skew:                           1.059   Prob(JB):                         0.00
Kurtosis:                      19.206   Cond. No.                         12.3
==============================================================================

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

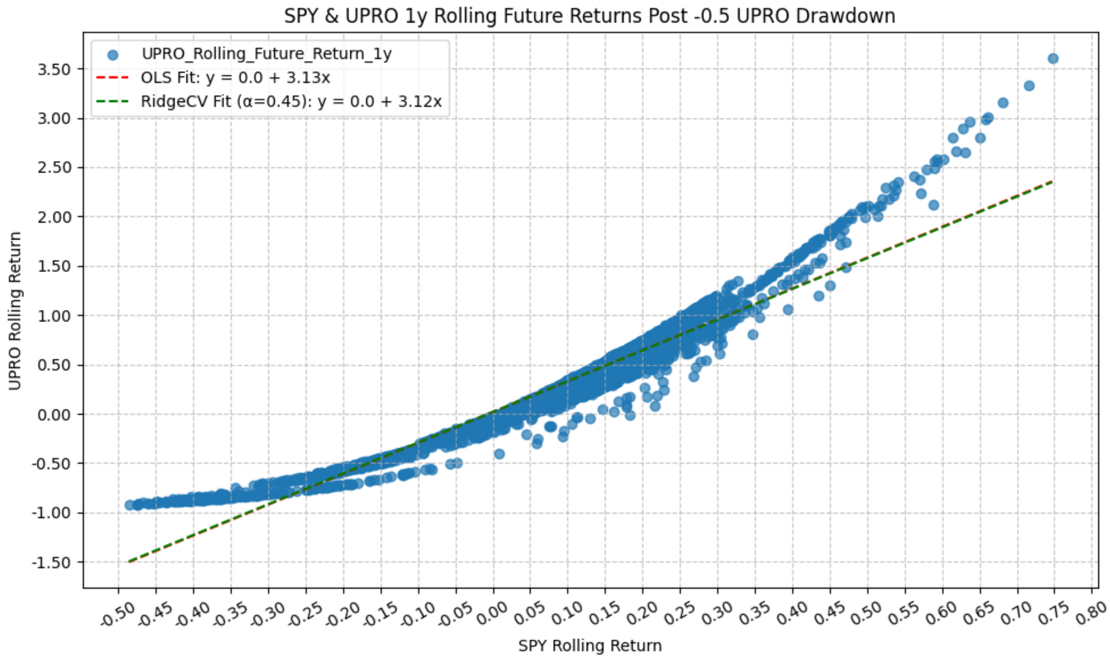





```
                                     OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_6m   R-squared:
0.957
Model:                                       OLS   Adj. R-squared:
0.957
Method:                            Least Squares   F-statistic:
8.590e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:00   Log-Likelihood:
4532.3
No. Observations:                           3871   AIC:
-9061.
Df Residuals:                               3869   BIC:
-9048.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                            0.0067      0.001      5.300      0.000
```

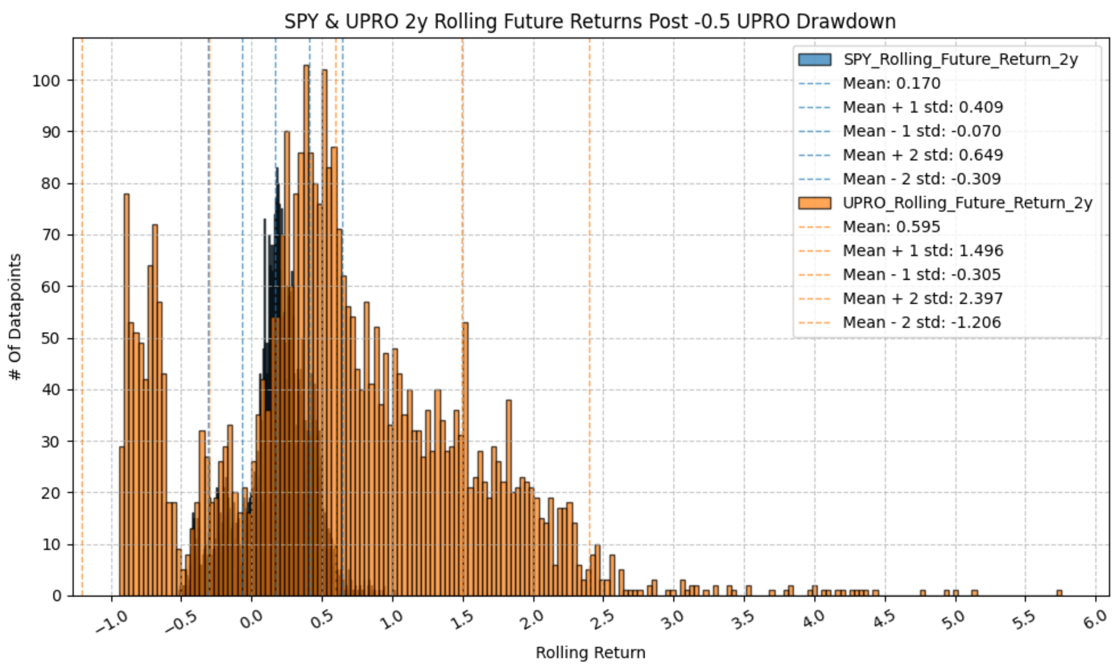
```
0.004       0.009
SPY_Rolling_Future_Return_6m     2.9569      0.010    293.089      0.000
2.937       2.977
==============================================================================
Omnibus:                     1292.768   Durbin-Watson:                   0.081
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             9397.773
Skew:                           1.396   Prob(JB):                         0.00
Kurtosis:                      10.104   Cond. No.                         8.37
==============================================================================

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

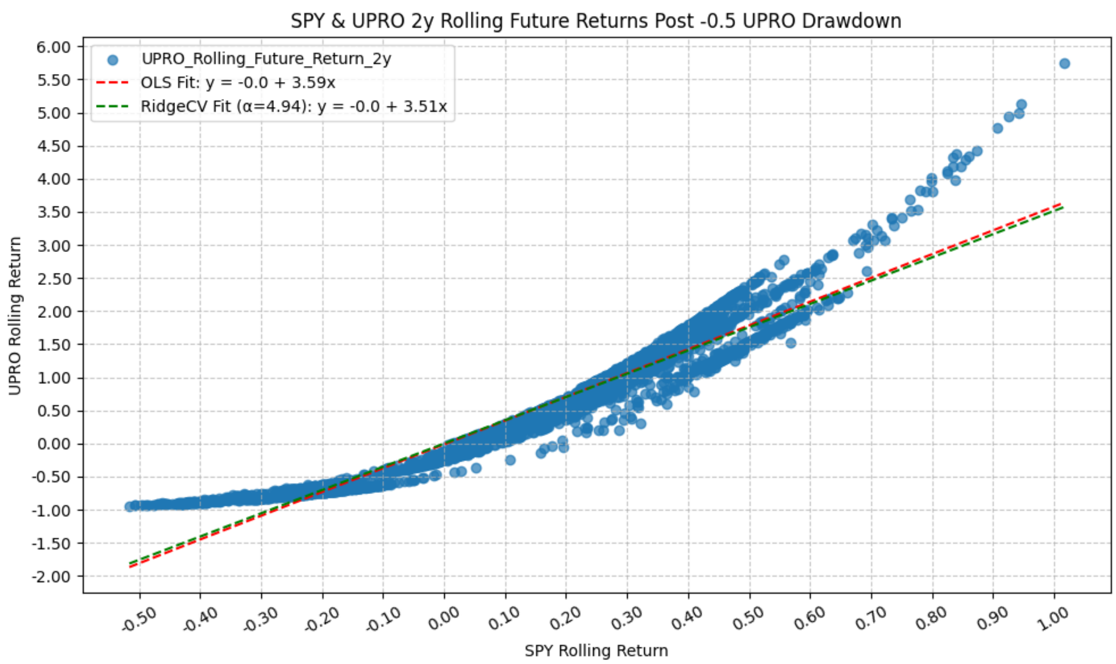





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1y   R-squared:
0.933
Model:                                       OLS   Adj. R-squared:
0.933
Method:                            Least Squares   F-statistic:
5.409e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:01   Log-Likelihood:
1958.2
No. Observations:                           3871   AIC:
-3912.
Df Residuals:                               3869   BIC:
-3900.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                            0.0174      0.003      6.787      0.000
```

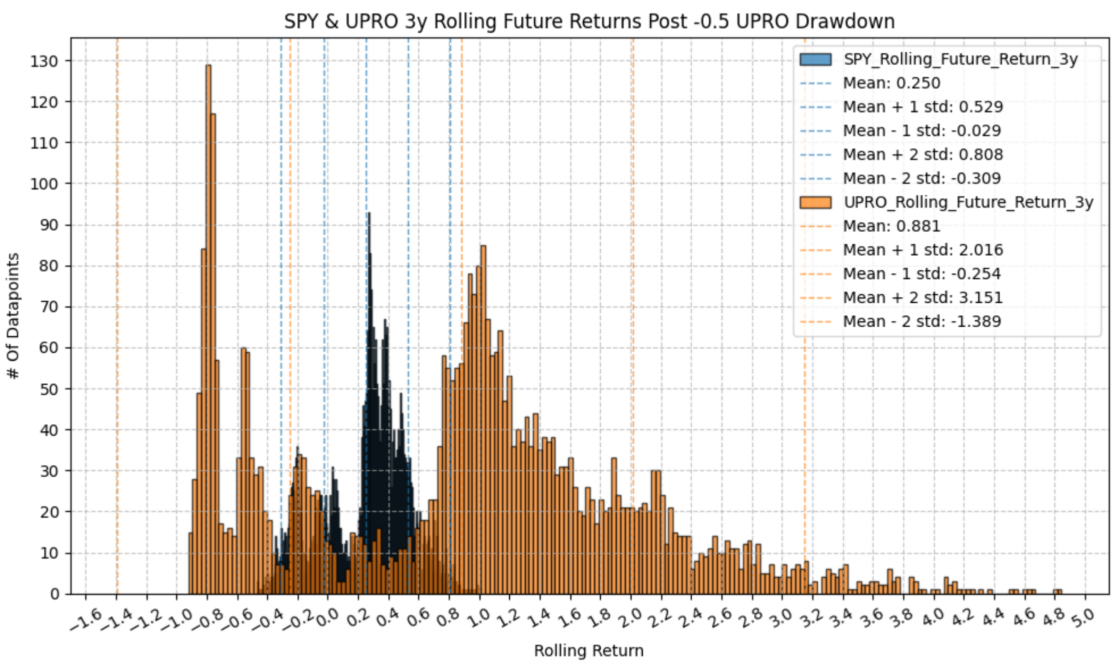
```
0.012       0.022
SPY_Rolling_Future_Return_1y     3.1291      0.013    232.562      0.000
3.103       3.155
==============================================================================
Omnibus:                     1514.882   Durbin-Watson:                   0.057
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            11136.976
Skew:                           1.682   Prob(JB):                         0.00
Kurtosis:                      10.598   Cond. No.                         5.77
==============================================================================

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

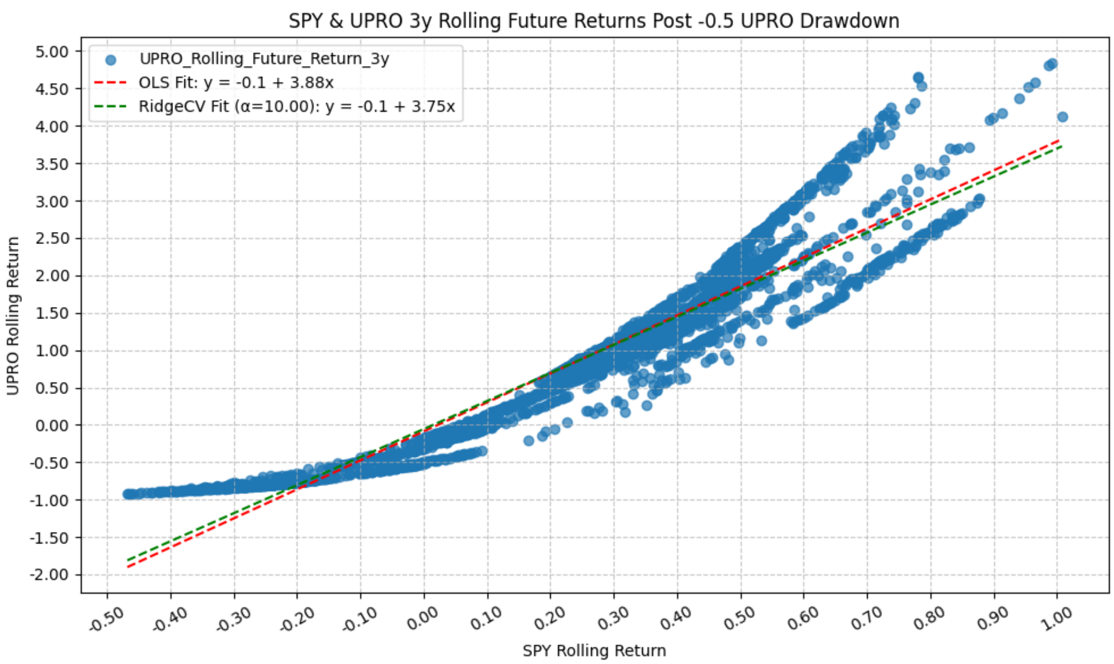





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_2y   R-squared:
0.912
Model:                                       OLS   Adj. R-squared:
0.912
Method:                            Least Squares   F-statistic:
4.022e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:02   Log-Likelihood:
-377.53
No. Observations:                           3871   AIC:
759.1
Df Residuals:                               3869   BIC:
771.6
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0141      0.005     -2.685      0.007
```

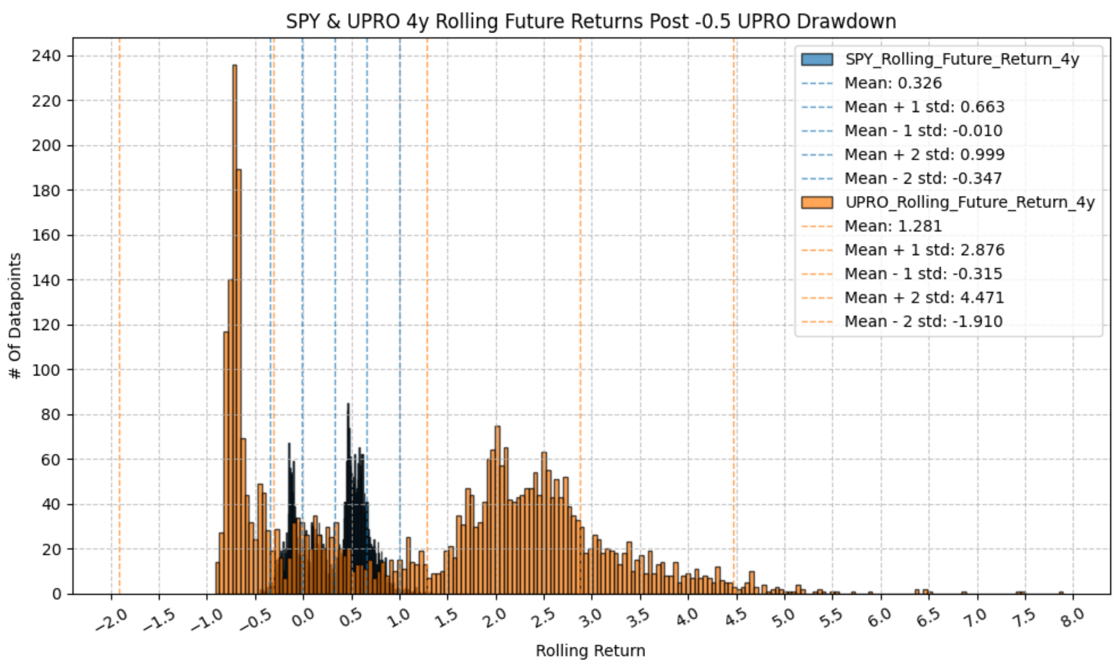
```
-0.024      -0.004
SPY_Rolling_Future_Return_2y     3.5921      0.018     200.550      0.000
3.557       3.627
==============================================================================
Omnibus:                     1084.267   Durbin-Watson:                   0.036
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             3631.483
Skew:                           1.395   Prob(JB):                         0.00
Kurtosis:                       6.839   Cond. No.                         4.30
==============================================================================

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

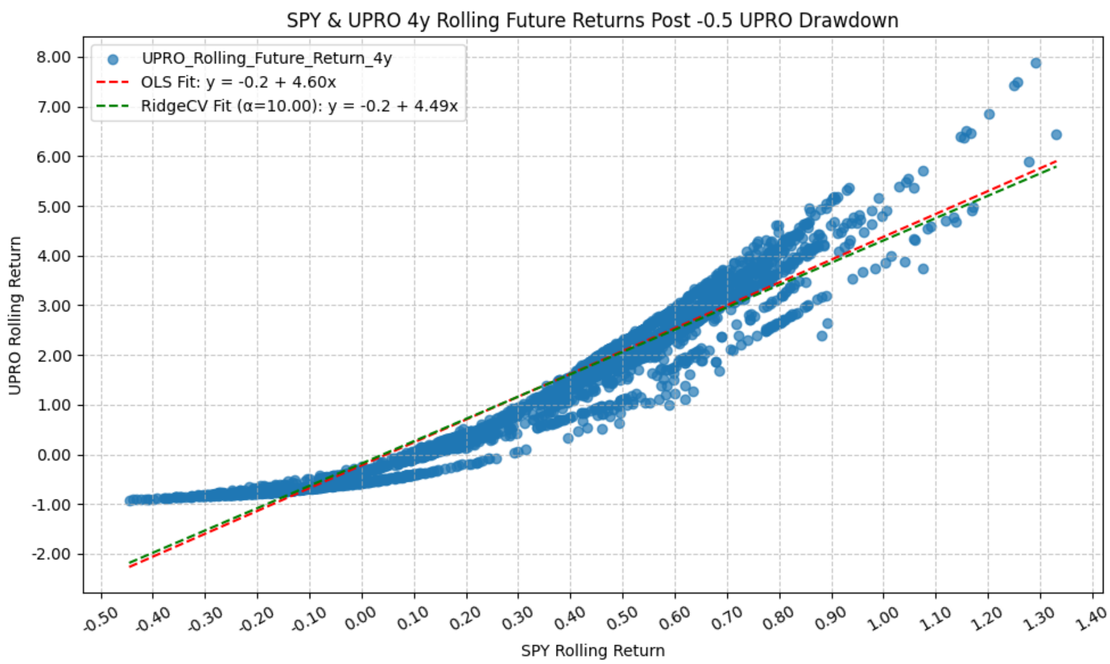





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3y   R-squared:
0.911
Model:                                       OLS   Adj. R-squared:
0.911
Method:                            Least Squares   F-statistic:
3.909e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:03   Log-Likelihood:
-1292.1
No. Observations:                           3832   AIC:
2588.
Df Residuals:                               3830   BIC:
2601.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.0884      0.007    -12.033      0.000
```

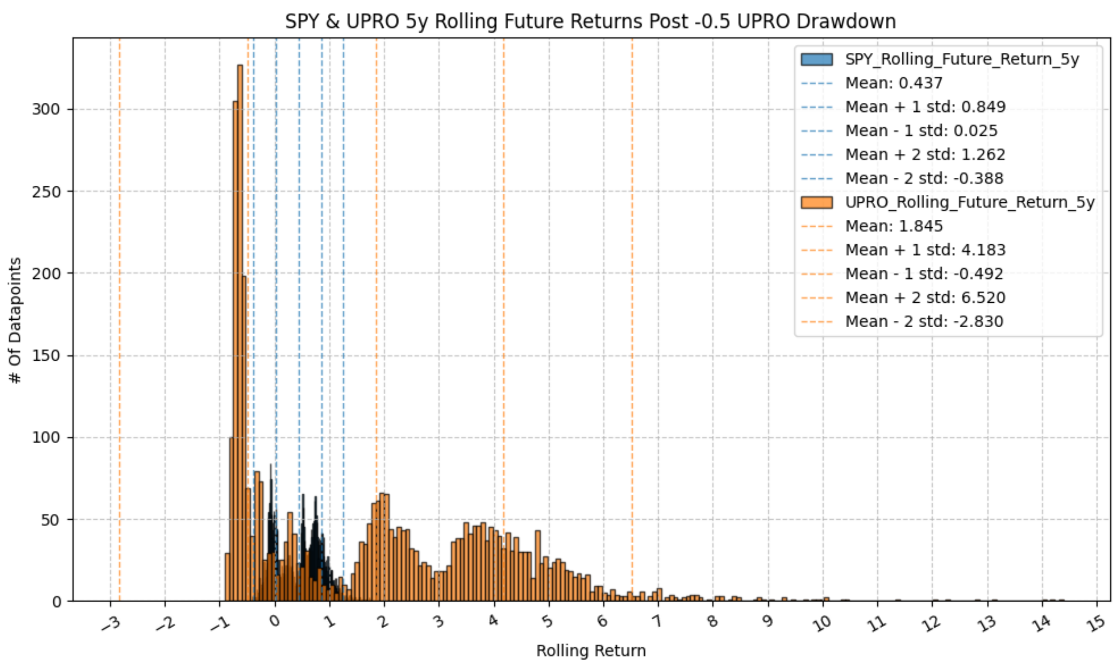
```
-0.103      -0.074
SPY_Rolling_Future_Return_3y     3.8786      0.020    197.723      0.000
3.840       3.917
==============================================================================
Omnibus:                      631.089   Durbin-Watson:                   0.022
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1399.356
Skew:                           0.954   Prob(JB):                    1.36e-304
Kurtosis:                       5.263   Cond. No.                         3.82
==============================================================================

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

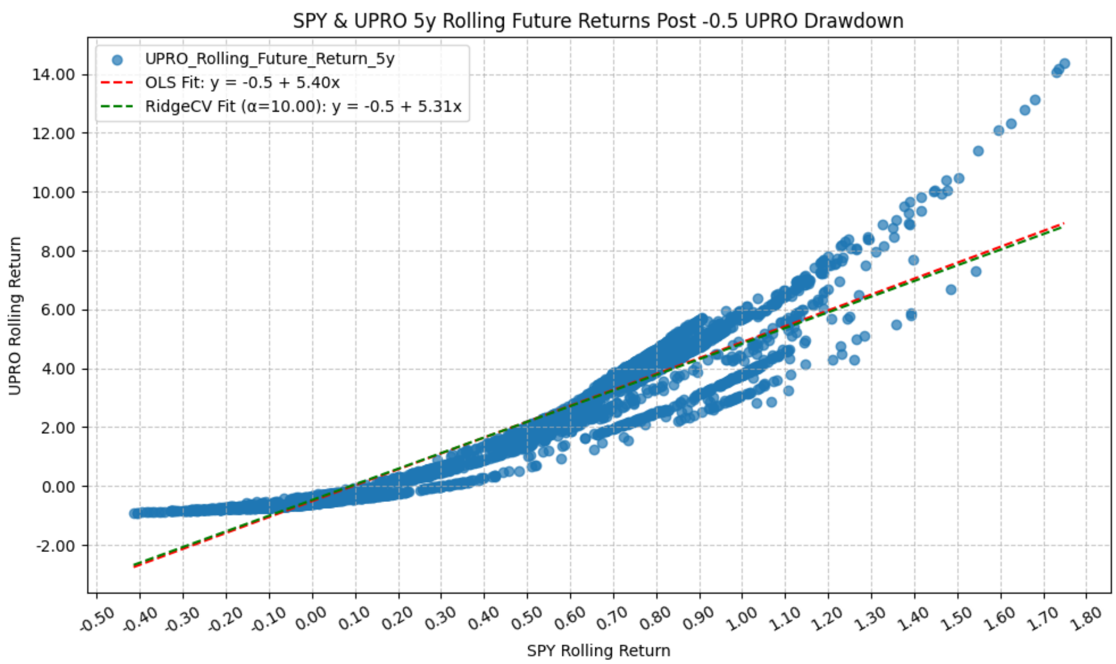





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_4y   R-squared:
0.940
Model:                                       OLS   Adj. R-squared:
0.940
Method:                            Least Squares   F-statistic:
5.811e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:04   Log-Likelihood:
-1764.0
No. Observations:                           3696   AIC:
3532.
Df Residuals:                               3694   BIC:
3544.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                              coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                      -0.2199      0.009    -24.595      0.000
```

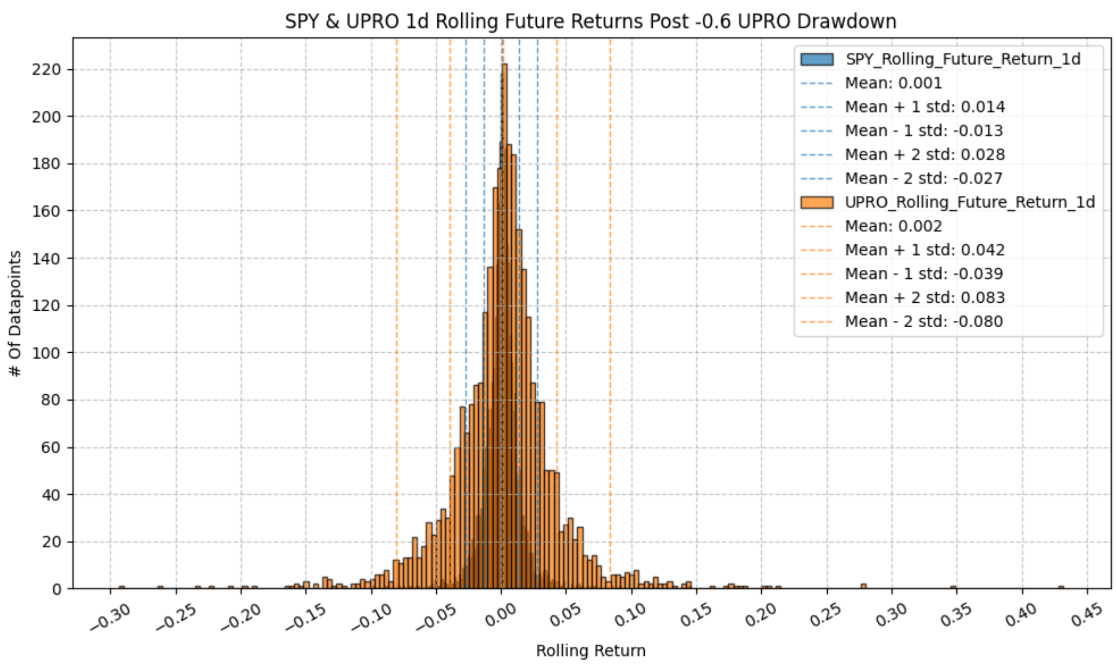
```
-0.237      -0.202
SPY_Rolling_Future_Return_4y     4.5978      0.019    241.056      0.000
4.560       4.635
==============================================================================
Omnibus:                      141.094   Durbin-Watson:                   0.030
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              415.728
Skew:                           0.068   Prob(JB):                     5.32e-91
Kurtosis:                       4.637   Cond. No.                         3.32
==============================================================================

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

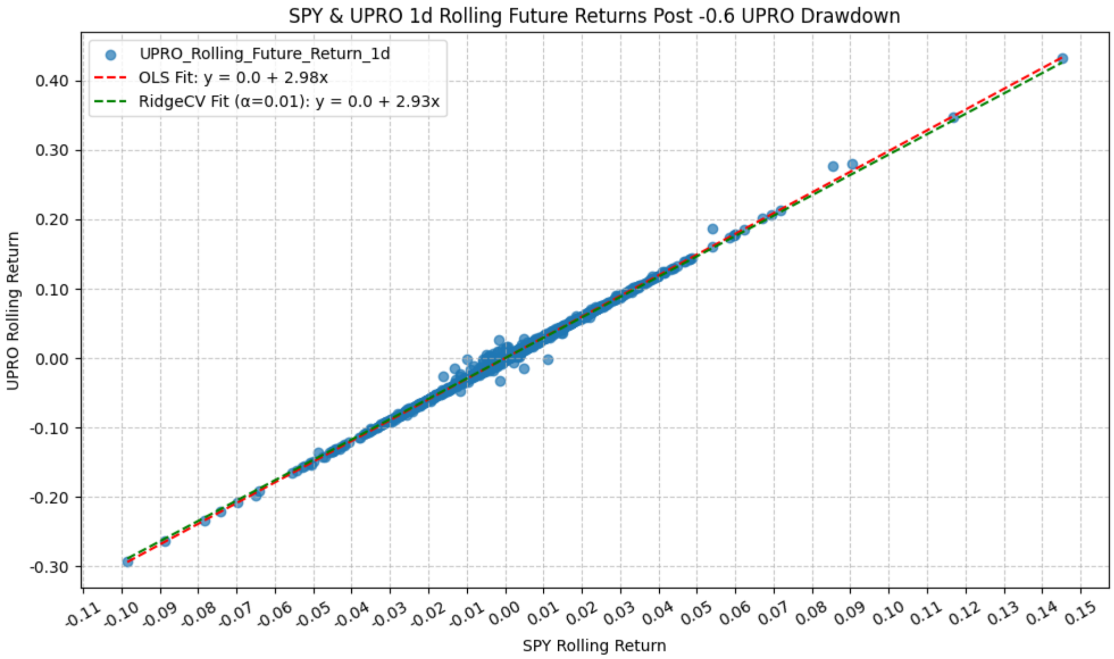





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_5y   R-squared:
0.907
Model:                                       OLS   Adj. R-squared:
0.907
Method:                            Least Squares   F-statistic:
3.594e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:05   Log-Likelihood:
-3996.6
No. Observations:                           3696   AIC:
7997.
Df Residuals:                               3694   BIC:
8010.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.5139      0.017    -30.042      0.000
```

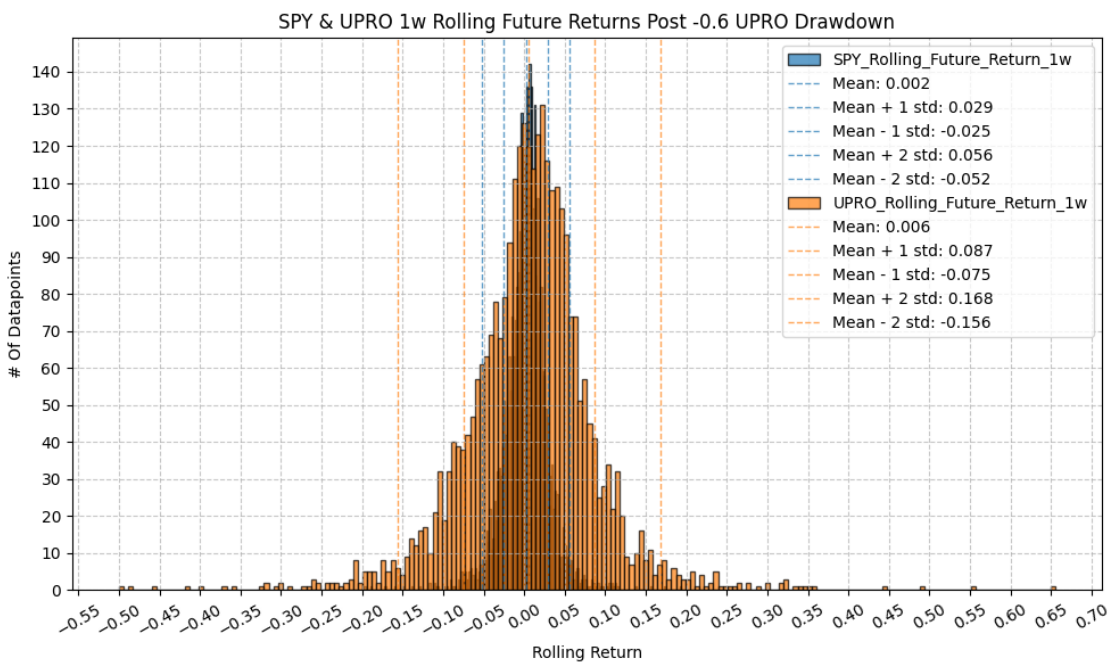
```
-0.547      -0.480
SPY_Rolling_Future_Return_5y     5.3991      0.028    189.589      0.000
5.343       5.455
==============================================================================
Omnibus:                      551.159   Durbin-Watson:                   0.022
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             2881.358
Skew:                           0.609   Prob(JB):                         0.00
Kurtosis:                       7.151   Cond. No.                         2.96
==============================================================================

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

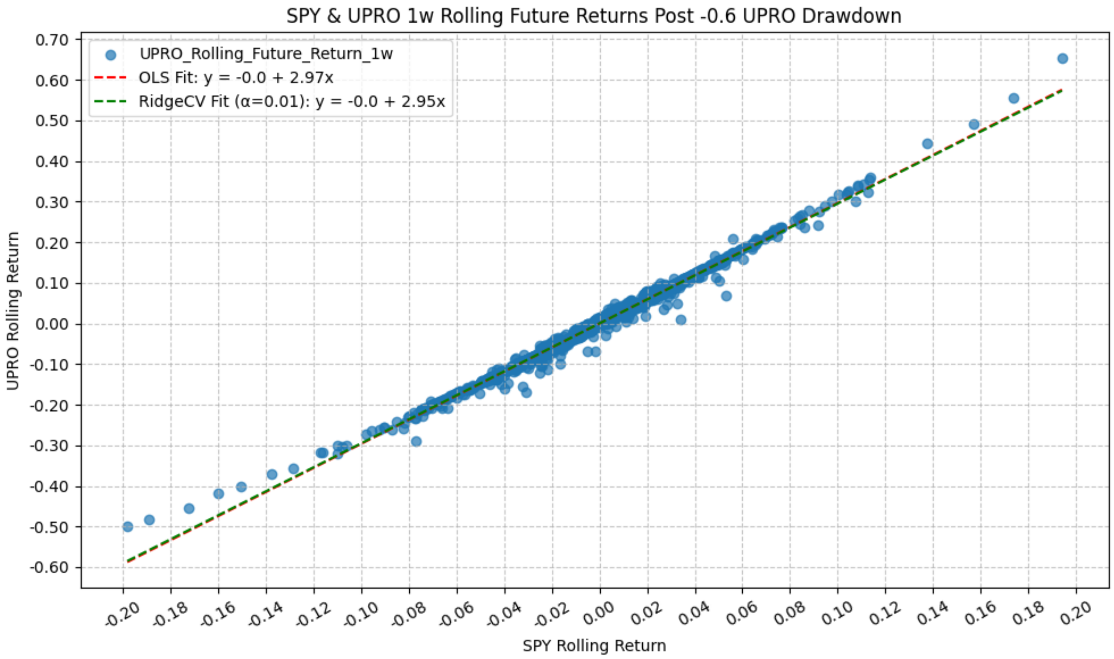





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1d   R-squared:
0.997
Model:                                       OLS   Adj. R-squared:
0.997
Method:                            Least Squares   F-statistic:
1.059e+06
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:07   Log-Likelihood:
14432.
No. Observations:                           3070   AIC:
-2.886e+04
Df Residuals:                               3068   BIC:
-2.885e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         7.42e-05   3.97e-05      1.868      0.062
```

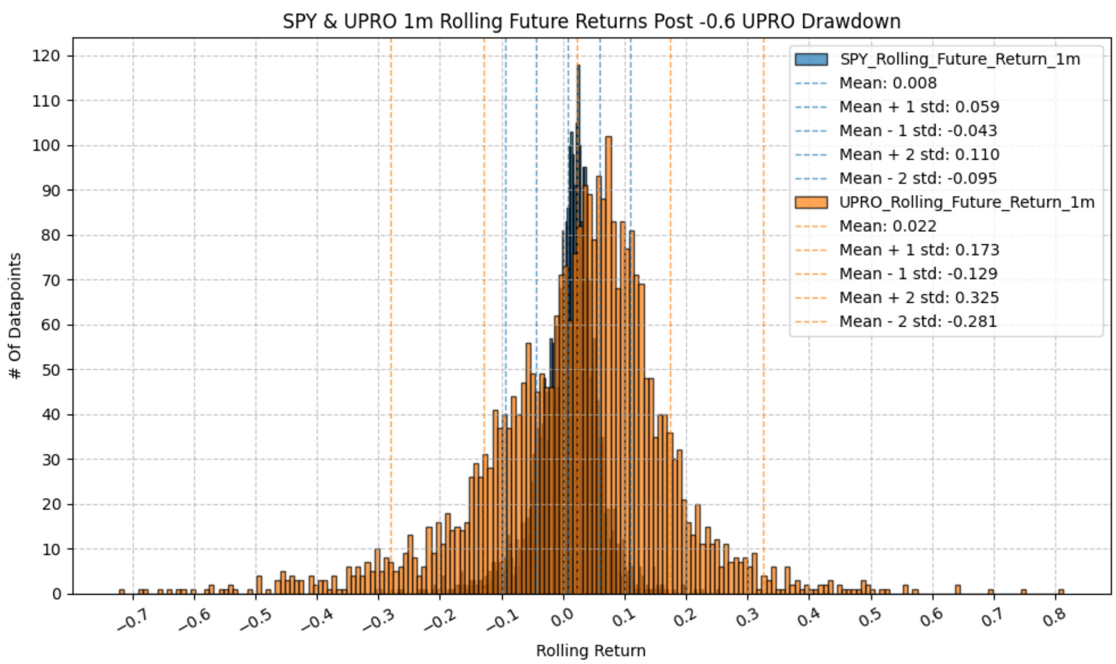
```
-3.69e-06         0.000
SPY_Rolling_Future_Return_1d      2.9825       0.003    1028.945       0.000
2.977        2.988
==============================================================================
Omnibus:                     2273.218   Durbin-Watson:                   2.537
Prob(Omnibus):                  0.000   Jarque-Bera (JB):          1053036.968
Skew:                           2.319   Prob(JB):                         0.00
Kurtosis:                      93.613   Cond. No.                         73.0
==============================================================================

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

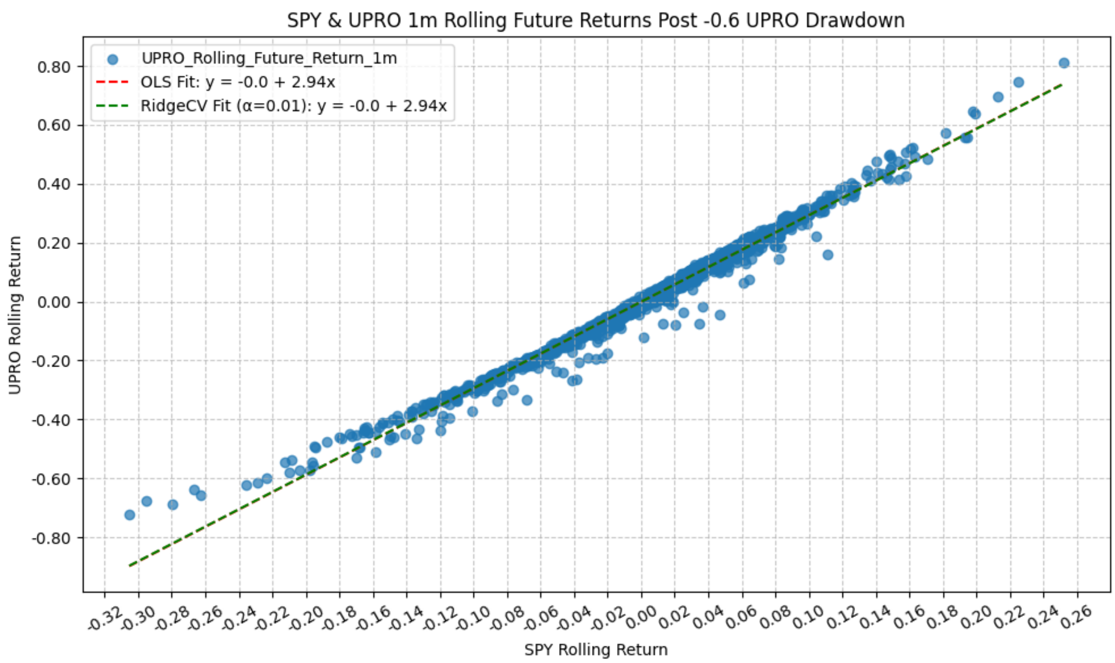





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1w   R-squared:
0.992
Model:                                       OLS   Adj. R-squared:
0.992
Method:                            Least Squares   F-statistic:
3.762e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:08   Log-Likelihood:
10750.
No. Observations:                           3070   AIC:
-2.150e+04
Df Residuals:                               3068   BIC:
-2.148e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0001      0.000     -1.043      0.297
```

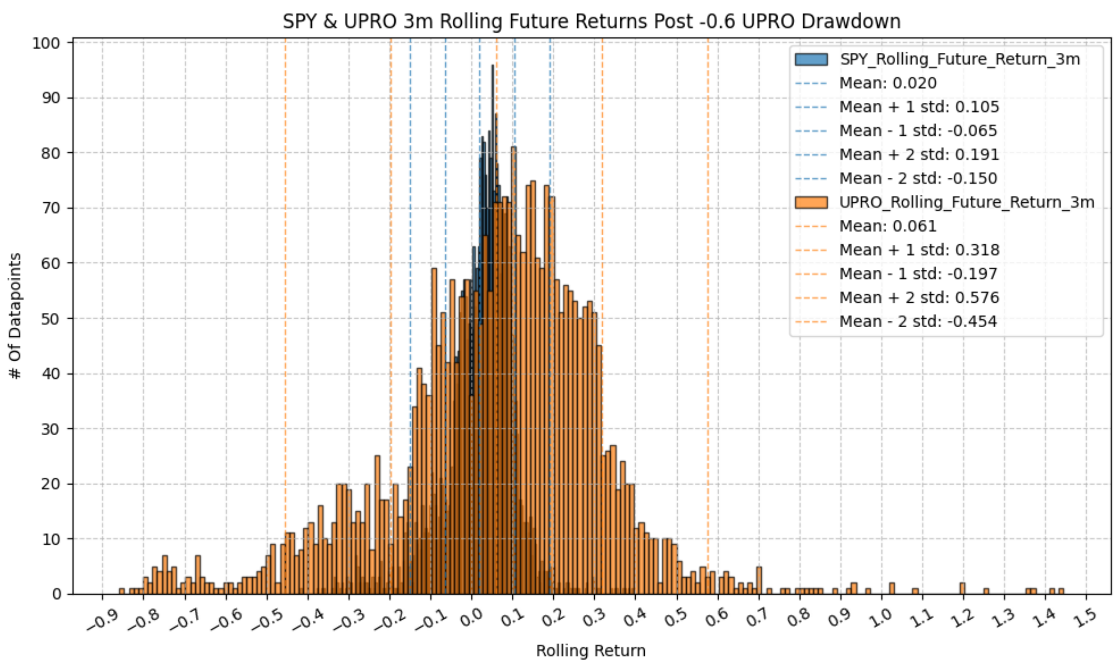
```
-0.000       0.000
SPY_Rolling_Future_Return_1w     2.9678      0.005    613.318      0.000
2.958       2.977
==============================================================================
Omnibus:                     1399.948   Durbin-Watson:                   1.060
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           313435.830
Skew:                          -0.997   Prob(JB):                         0.00
Kurtosis:                      52.460   Cond. No.                         36.7
==============================================================================

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

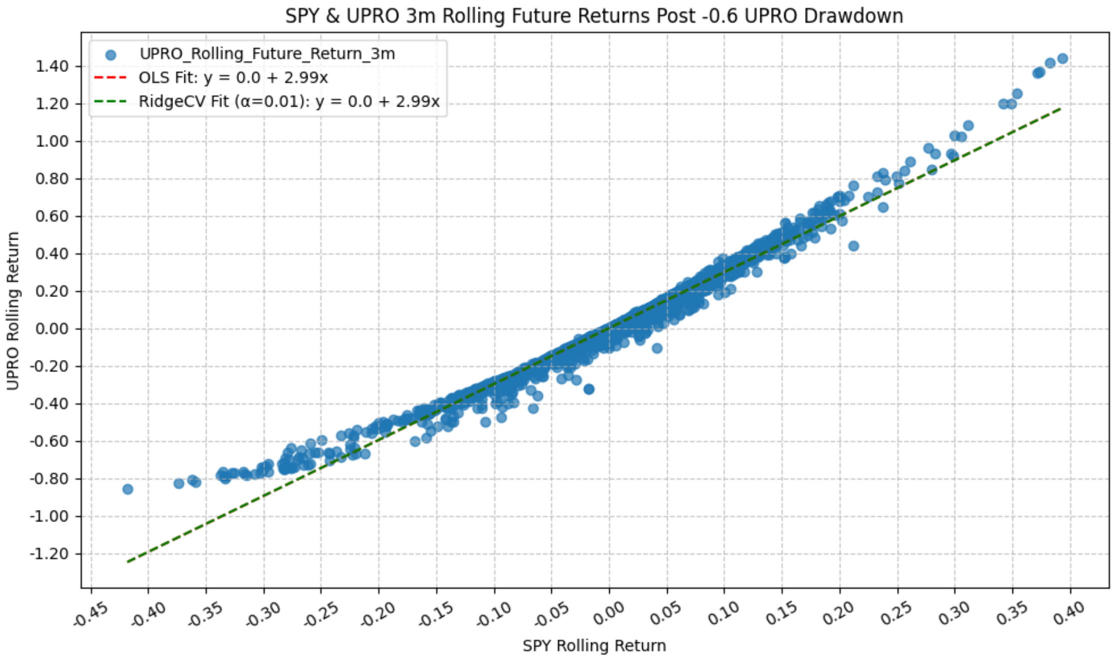





```
                                    OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1m   R-squared:
0.986
Model:                                       OLS   Adj. R-squared:
0.986
Method:                            Least Squares   F-statistic:
2.086e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:09   Log-Likelihood:
7938.3
No. Observations:                           3070   AIC:
-1.587e+04
Df Residuals:                               3068   BIC:
-1.586e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0006      0.000     -1.711      0.087
```

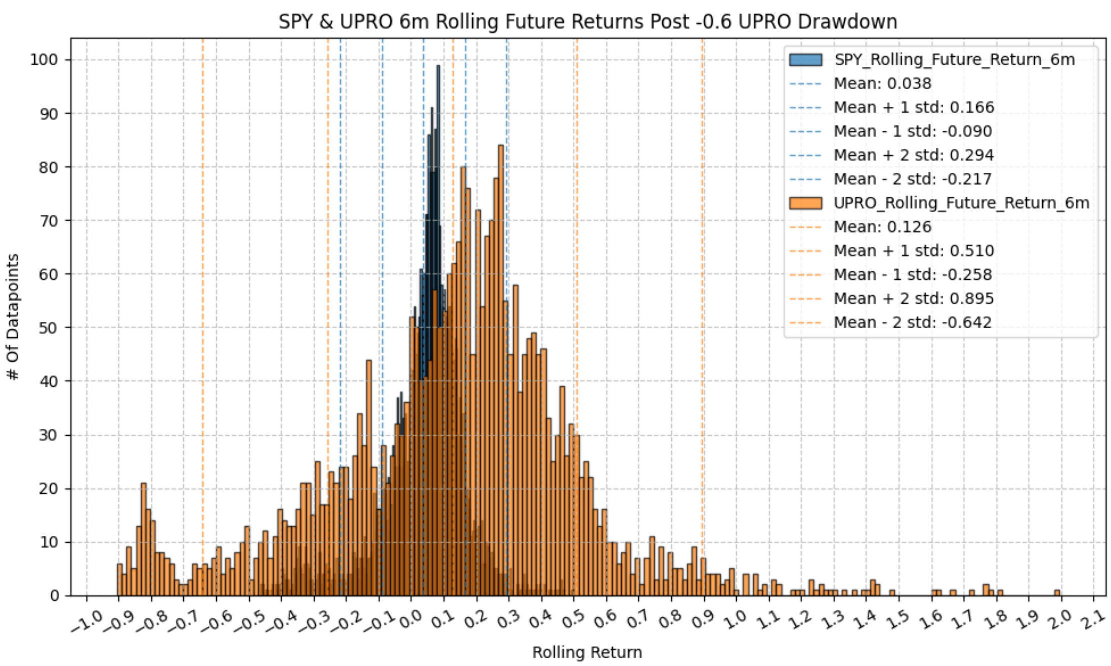
```
-0.001      8.3e-05
SPY_Rolling_Future_Return_1m      2.9397       0.006     456.774       0.000
2.927       2.952
==============================================================================
Omnibus:                     1387.733   Durbin-Watson:                   0.407
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           109426.463
Skew:                          -1.256   Prob(JB):                         0.00
Kurtosis:                      32.140   Cond. No.                         19.6
==============================================================================

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

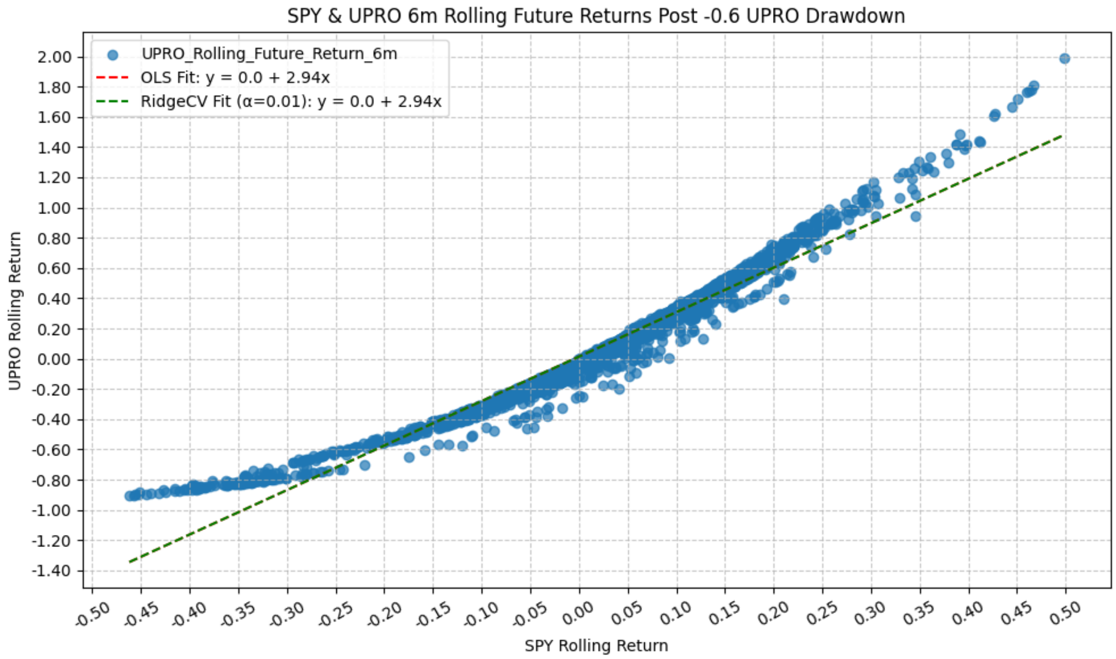





```
                                OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3m   R-squared:
0.977
Model:                                       OLS   Adj. R-squared:
0.977
Method:                            Least Squares   F-statistic:
1.313e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:10   Log-Likelihood:
5610.5
No. Observations:                           3070   AIC:
-1.122e+04
Df Residuals:                               3068   BIC:
-1.121e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                            0.0004      0.001      0.589      0.556
```

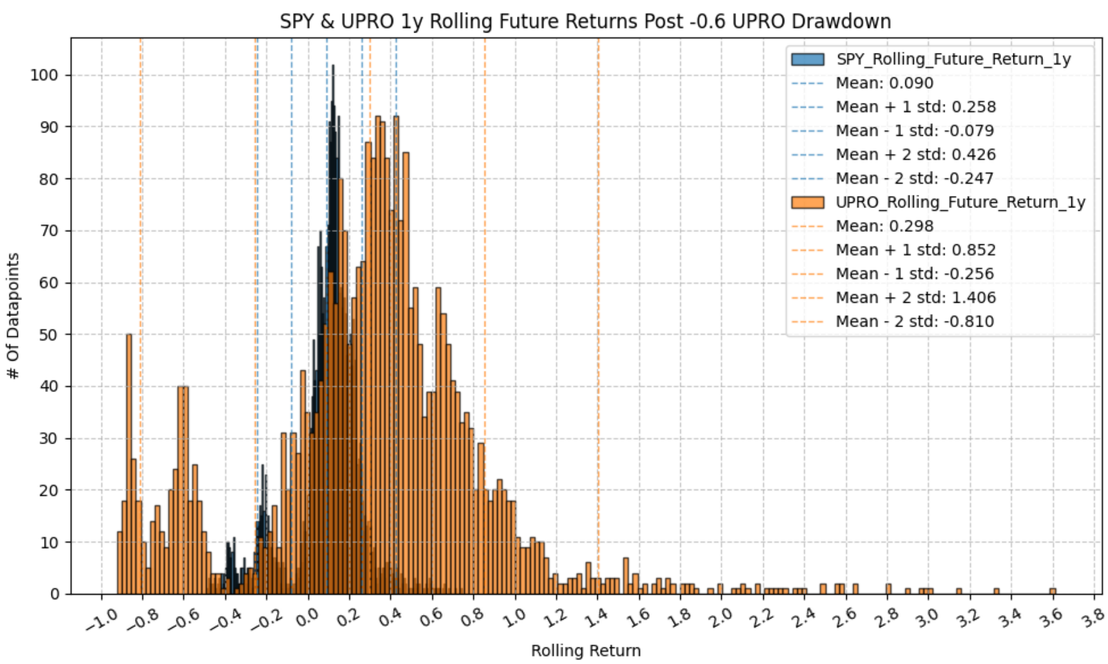
```
-0.001      0.002
SPY_Rolling_Future_Return_3m     2.9878      0.008    362.348      0.000
2.972      3.004
==============================================================================
Omnibus:                     1129.279   Durbin-Watson:                   0.193
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            29419.559
Skew:                           1.166   Prob(JB):                         0.00
Kurtosis:                      17.985   Cond. No.                         11.7
==============================================================================

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

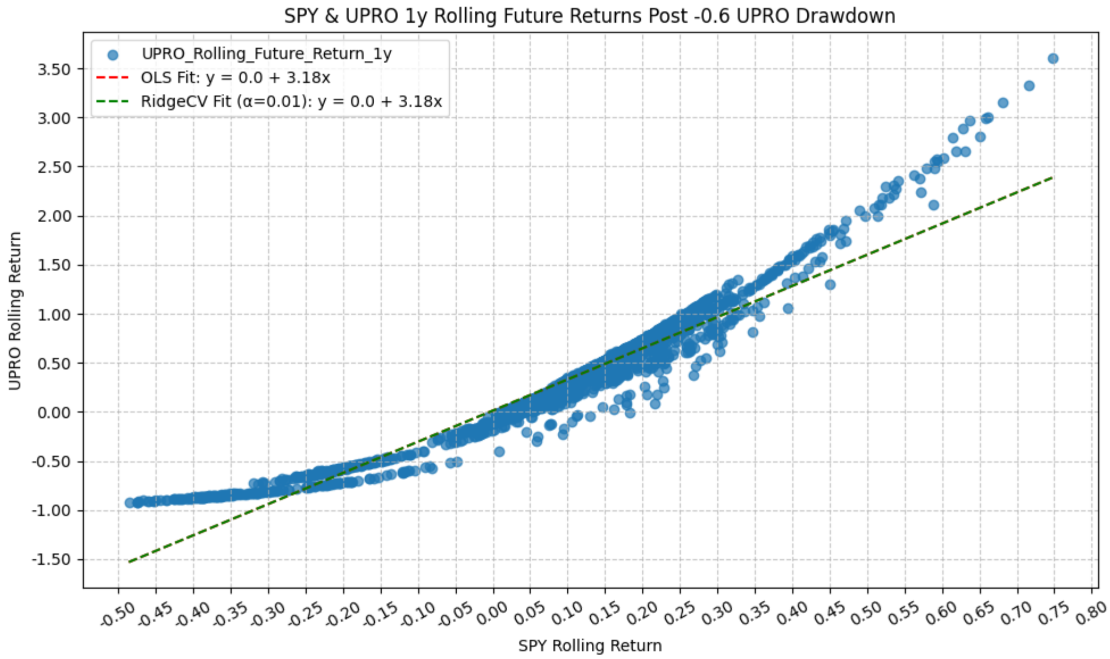





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_6m   R-squared:
0.956
Model:                                       OLS   Adj. R-squared:
0.956
Method:                            Least Squares   F-statistic:
6.658e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:11   Log-Likelihood:
3373.6
No. Observations:                           3070   AIC:
-6743.
Df Residuals:                               3068   BIC:
-6731.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                            0.0138      0.002      9.062      0.000
```

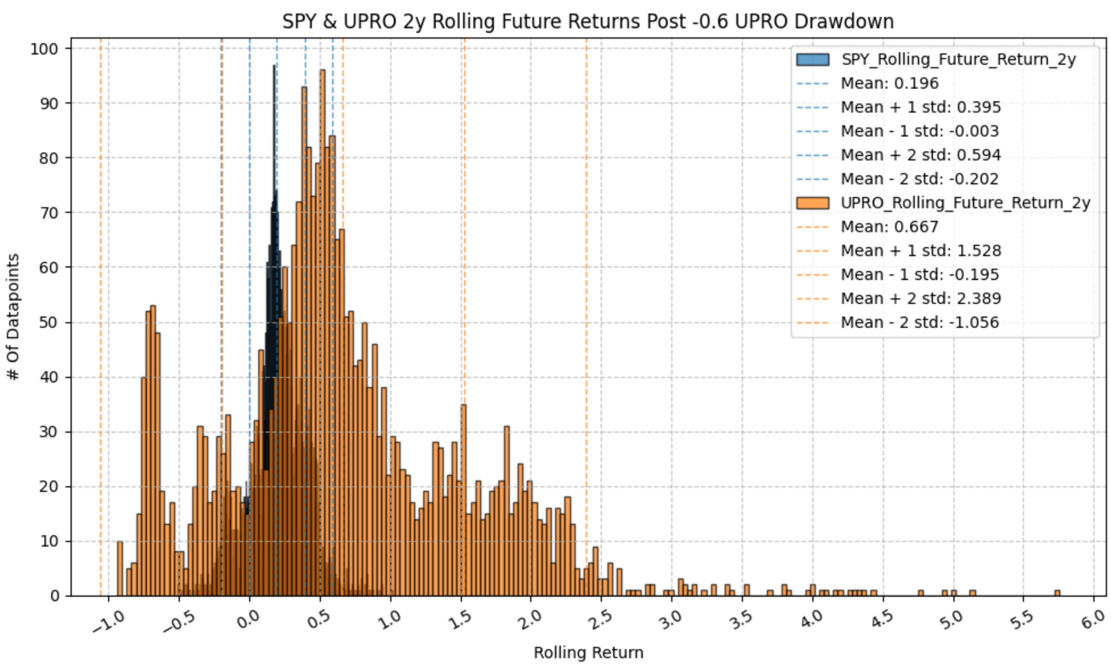
```
0.011       0.017
SPY_Rolling_Future_Return_6m     2.9412      0.011    258.024      0.000
2.919       2.964
==============================================================================
Omnibus:                      862.196   Durbin-Watson:                   0.075
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             5064.599
Skew:                           1.201   Prob(JB):                         0.00
Kurtosis:                       8.816   Cond. No.                         7.84
==============================================================================

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

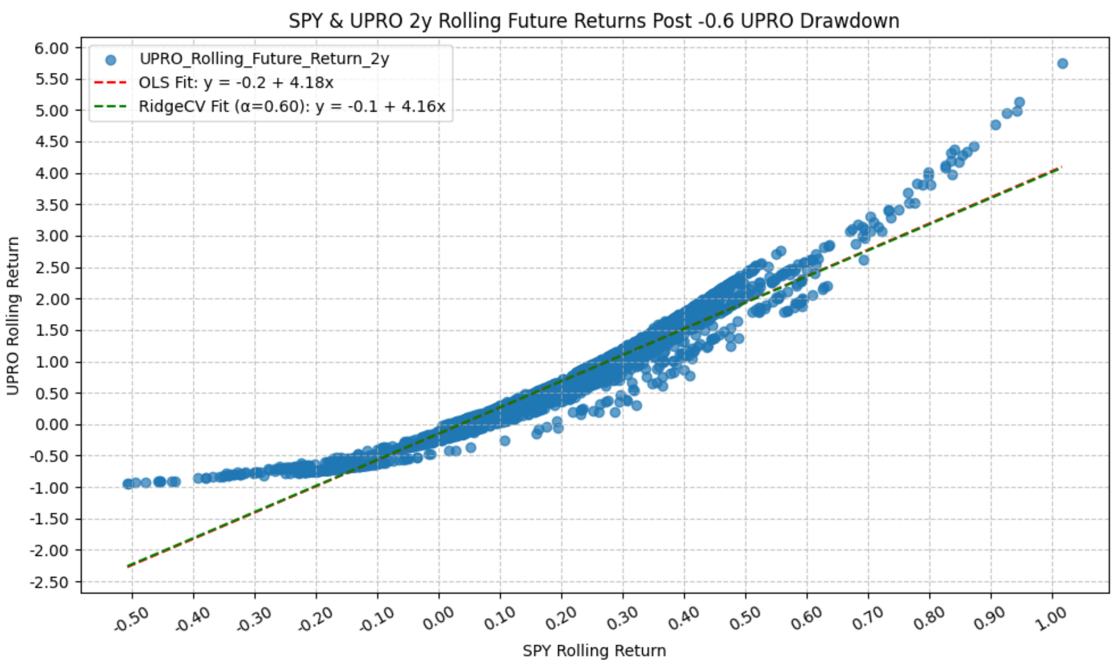





```
                                        OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1y   R-squared:
0.932
Model:                                       OLS   Adj. R-squared:
0.932
Method:                            Least Squares   F-statistic:
4.197e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:12   Log-Likelihood:
1581.2
No. Observations:                           3070   AIC:
-3158.
Df Residuals:                               3068   BIC:
-3146.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                            0.0132      0.003      4.453      0.000
```

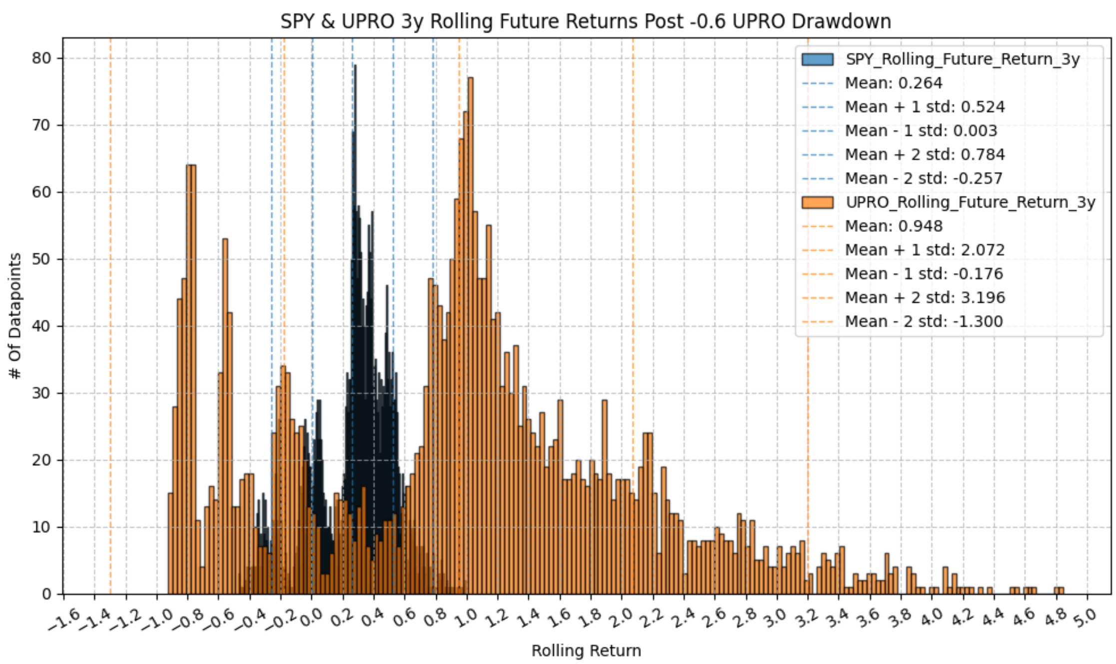
```
0.007       0.019
SPY_Rolling_Future_Return_1y     3.1762      0.016    204.862      0.000
3.146       3.207
==============================================================================
Omnibus:                     1210.909   Durbin-Watson:                   0.065
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            10511.033
Skew:                           1.634   Prob(JB):                         0.00
Kurtosis:                      11.455   Cond. No.                         5.99
==============================================================================

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

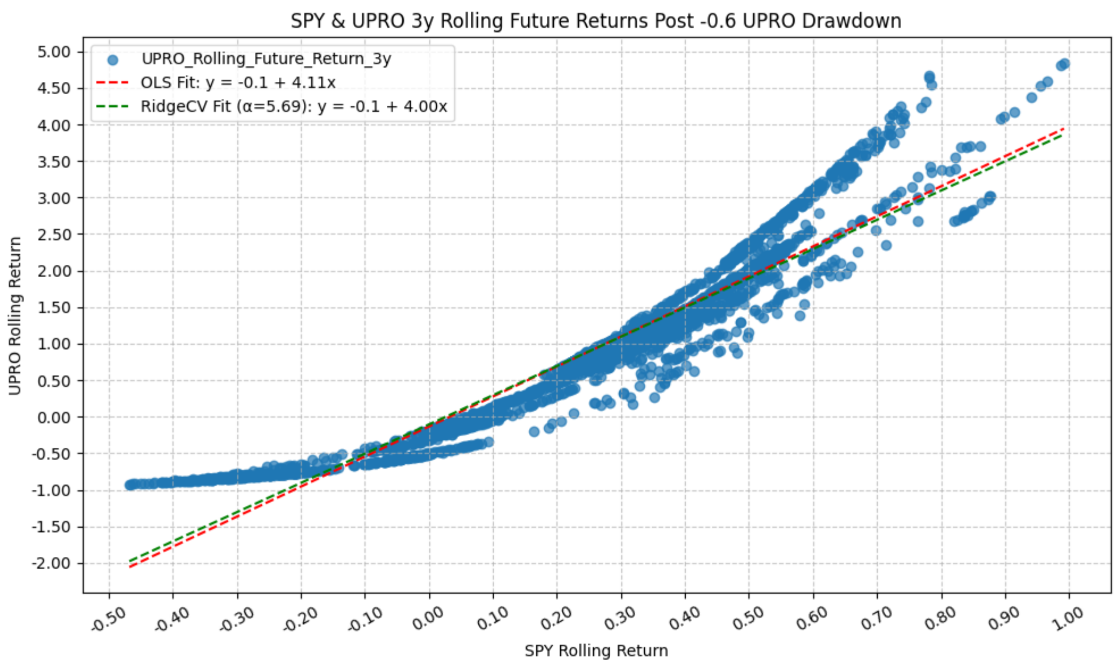





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_2y   R-squared:
0.932
Model:                                       OLS   Adj. R-squared:
0.932
Method:                            Least Squares   F-statistic:
4.210e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:14   Log-Likelihood:
230.85
No. Observations:                           3070   AIC:
-457.7
Df Residuals:                               3068   BIC:
-445.6
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.1524      0.006    -26.793      0.000
```

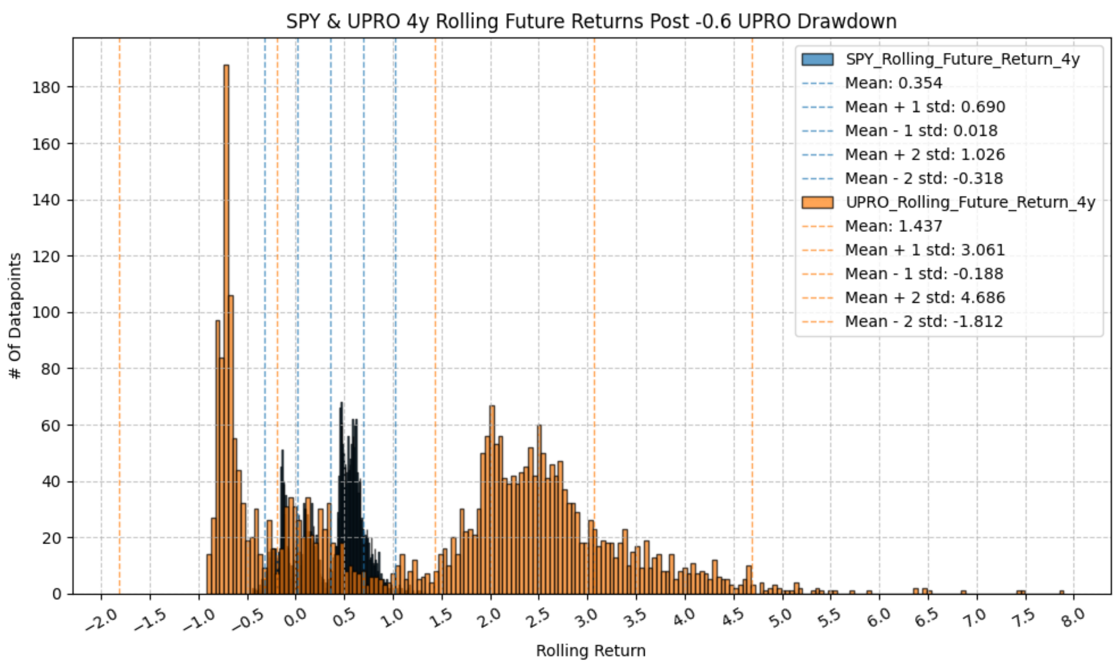
```
-0.164      -0.141
SPY_Rolling_Future_Return_2y      4.1802      0.020    205.190      0.000
4.140       4.220
==============================================================================
Omnibus:                      971.652   Durbin-Watson:                   0.048
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             5574.704
Skew:                           1.382   Prob(JB):                         0.00
Kurtosis:                       8.995   Cond. No.                         5.23
==============================================================================

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

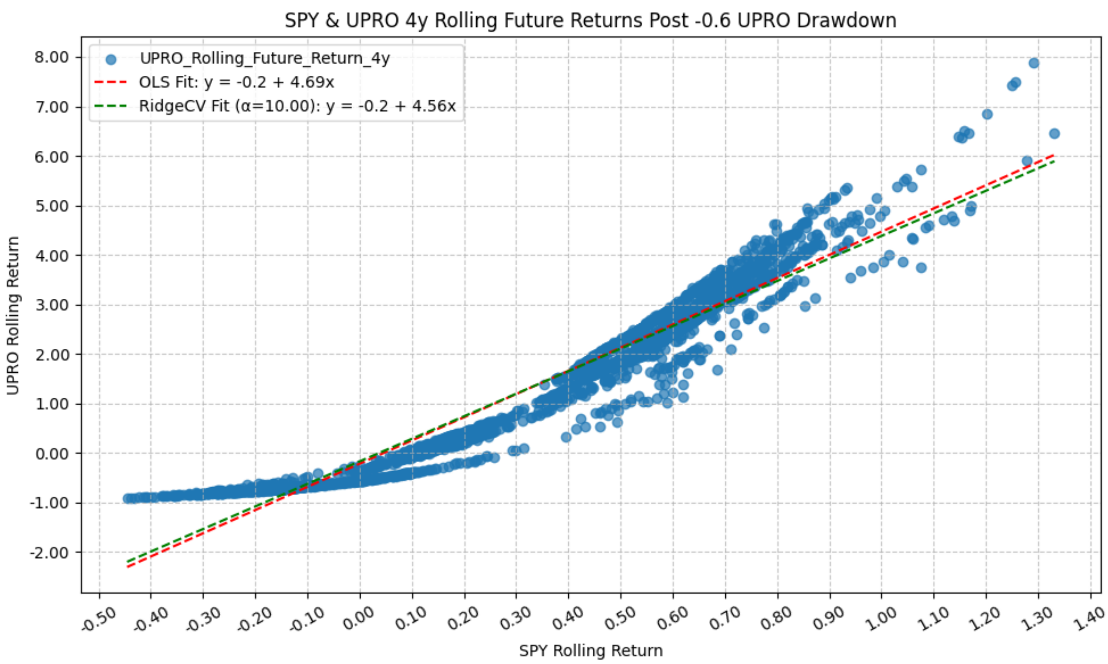





```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3y   R-squared:
0.906
Model:                                       OLS   Adj. R-squared:
0.906
Method:                            Least Squares   F-statistic:
2.942e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:15   Log-Likelihood:
-1092.7
No. Observations:                           3070   AIC:
2189.
Df Residuals:                               3068   BIC:
2201.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.1351      0.009    -15.223      0.000
```

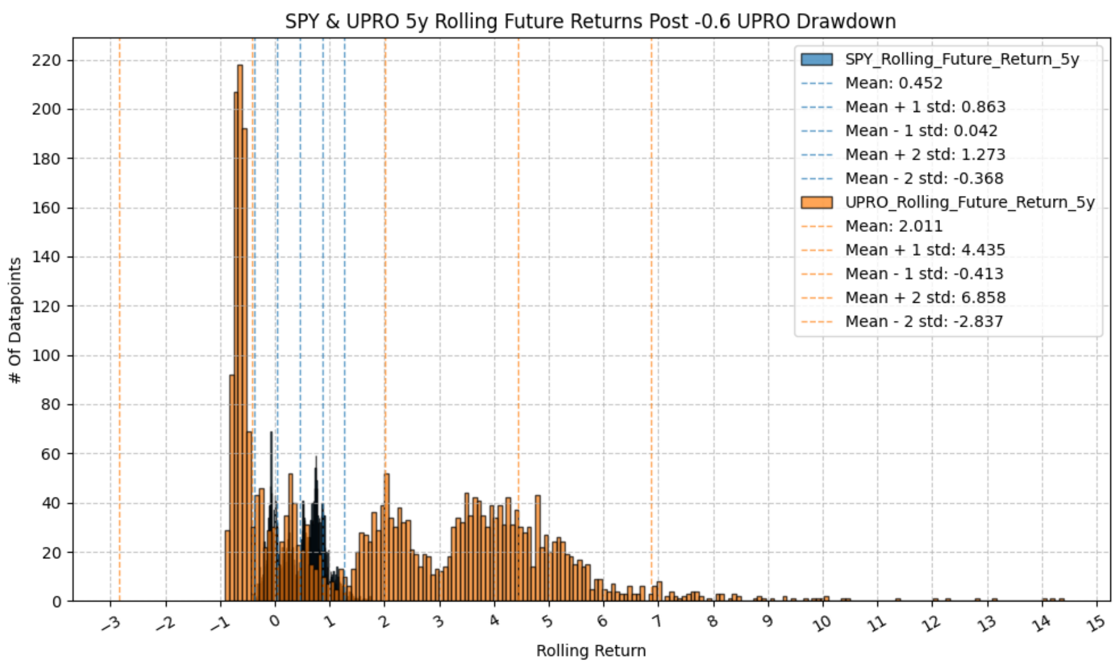
```
-0.153      -0.118
SPY_Rolling_Future_Return_3y     4.1099      0.024    171.519      0.000
4.063       4.157
==============================================================================
Omnibus:                      523.372   Durbin-Watson:                   0.022
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              948.088
Skew:                           1.070   Prob(JB):                    1.33e-206
Kurtosis:                       4.682   Cond. No.                         4.13
==============================================================================

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

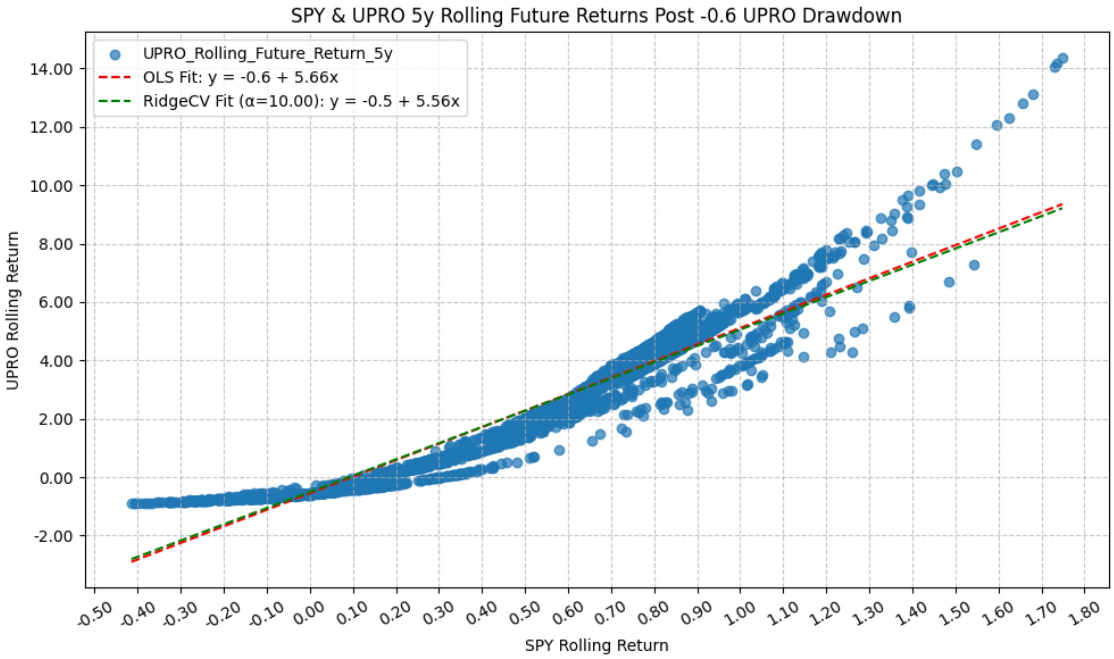





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_4y   R-squared:
0.942
Model:                                       OLS   Adj. R-squared:
0.942
Method:                            Least Squares   F-statistic:
4.920e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:16   Log-Likelihood:
-1478.5
No. Observations:                           3055   AIC:
2961.
Df Residuals:                               3053   BIC:
2973.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.2228      0.010    -21.595      0.000
```

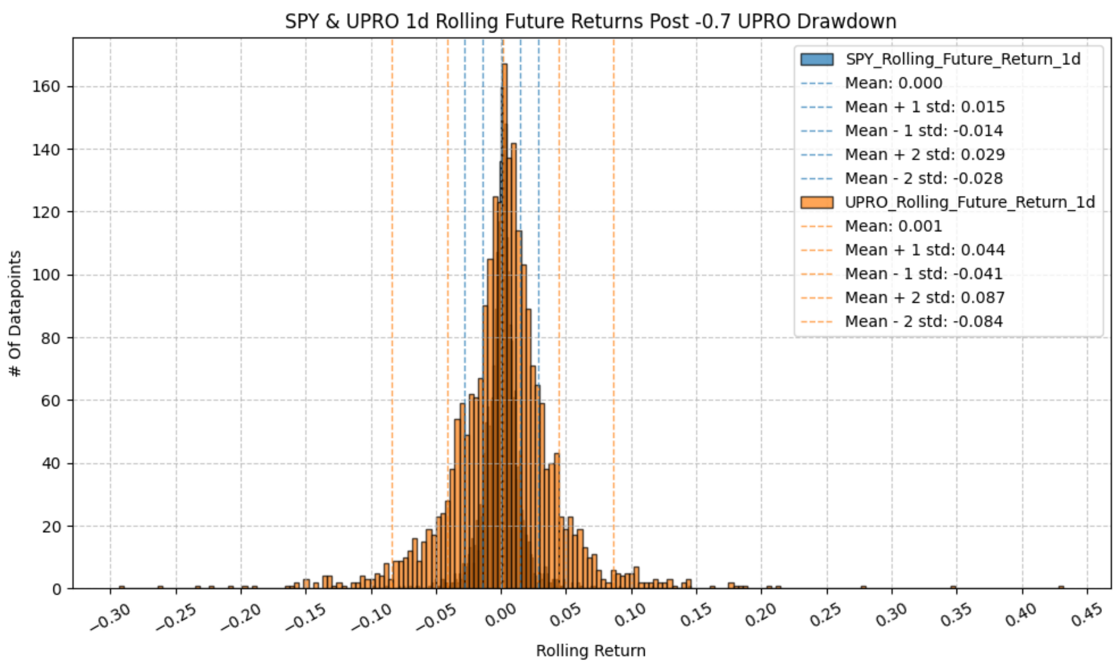
```
-0.243      -0.203
SPY_Rolling_Future_Return_4y     4.6897      0.021     221.807      0.000
4.648       4.731
==============================================================================
Omnibus:                      120.436   Durbin-Watson:                   0.033
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              311.979
Skew:                           0.172   Prob(JB):                     1.80e-68
Kurtosis:                       4.527   Cond. No.                         3.39
==============================================================================

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

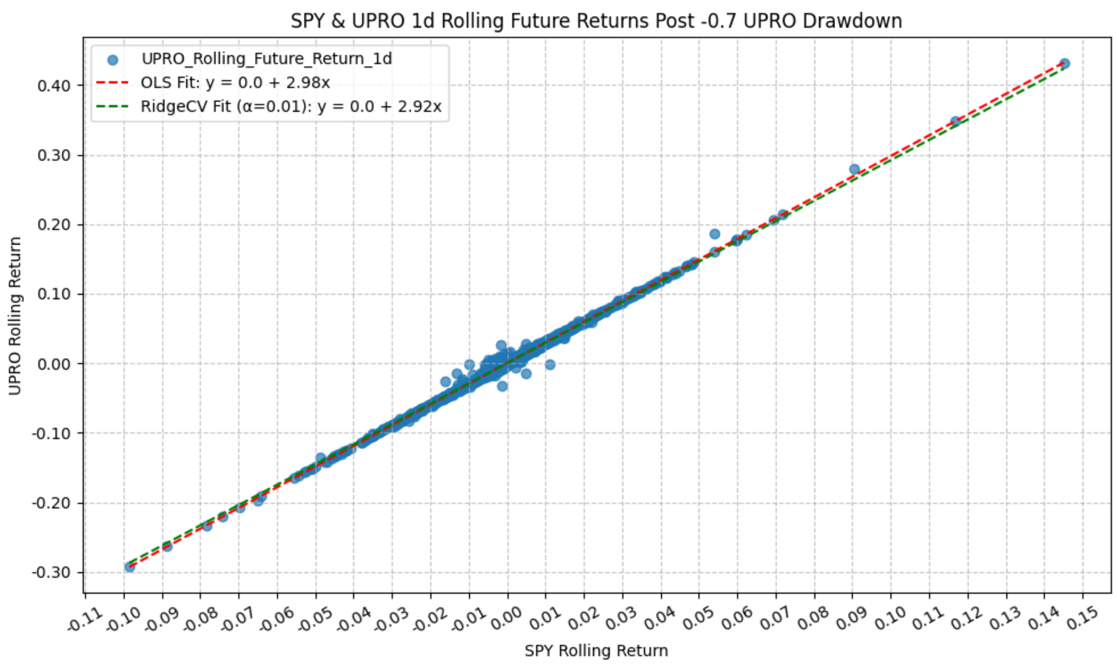





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_5y   R-squared:
0.919
Model:                                       OLS   Adj. R-squared:
0.919
Method:                            Least Squares   F-statistic:
3.475e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:17   Log-Likelihood:
-3195.7
No. Observations:                           3055   AIC:
6395.
Df Residuals:                               3053   BIC:
6407.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                 coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                         -0.5517      0.019    -29.728      0.000
```

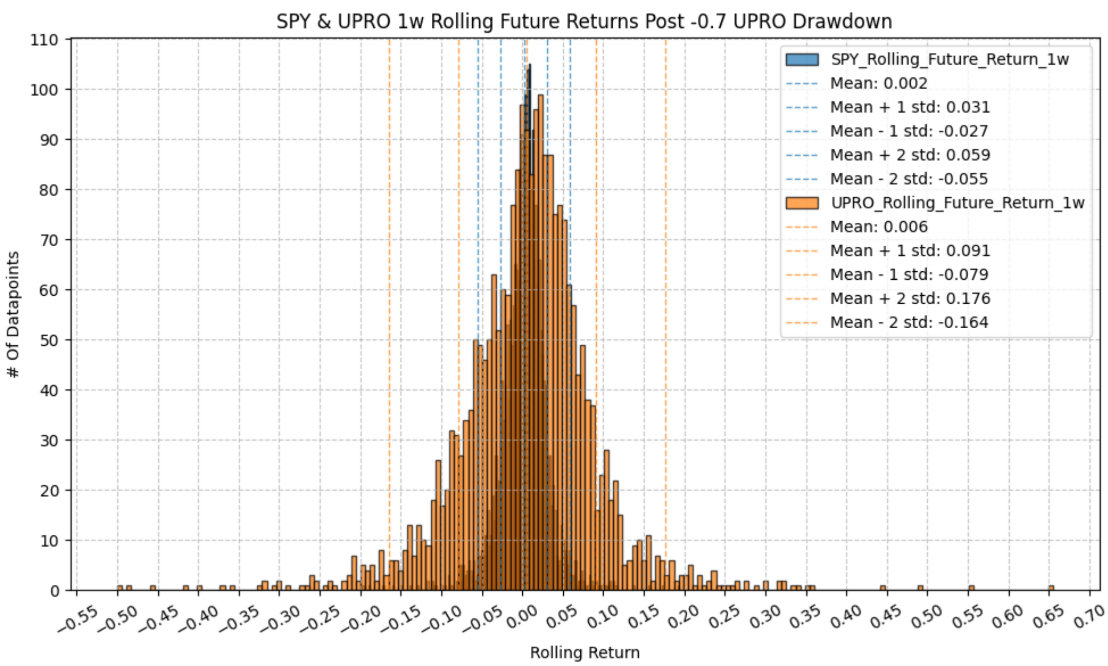
```
-0.588      -0.515
SPY_Rolling_Future_Return_5y     5.6649      0.030     186.400      0.000
5.605       5.724
==============================================================================
Omnibus:                      454.992   Durbin-Watson:                   0.025
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             2120.542
Skew:                           0.640   Prob(JB):                         0.00
Kurtosis:                       6.876   Cond. No.                         3.02
==============================================================================

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

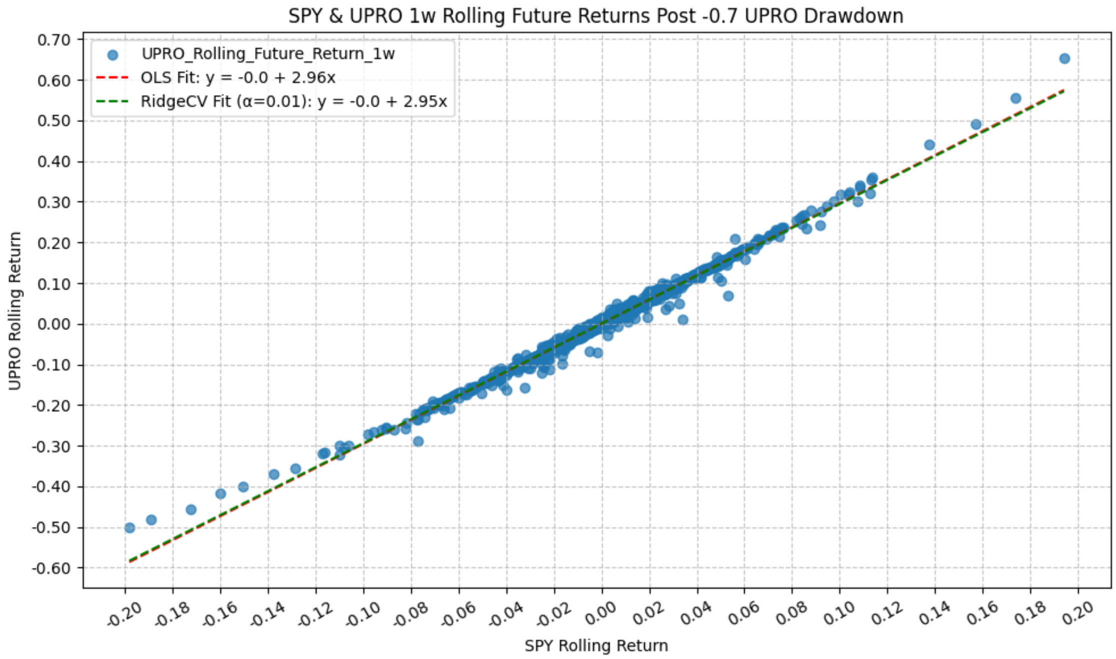





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1d   R-squared:
0.997
Model:                                       OLS   Adj. R-squared:
0.997
Method:                            Least Squares   F-statistic:
7.538e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:18   Log-Likelihood:
10930.
No. Observations:                           2365   AIC:
-2.186e+04
Df Residuals:                               2363   BIC:
-2.184e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                         8.908e-05    4.9e-05      1.818      0.069
```

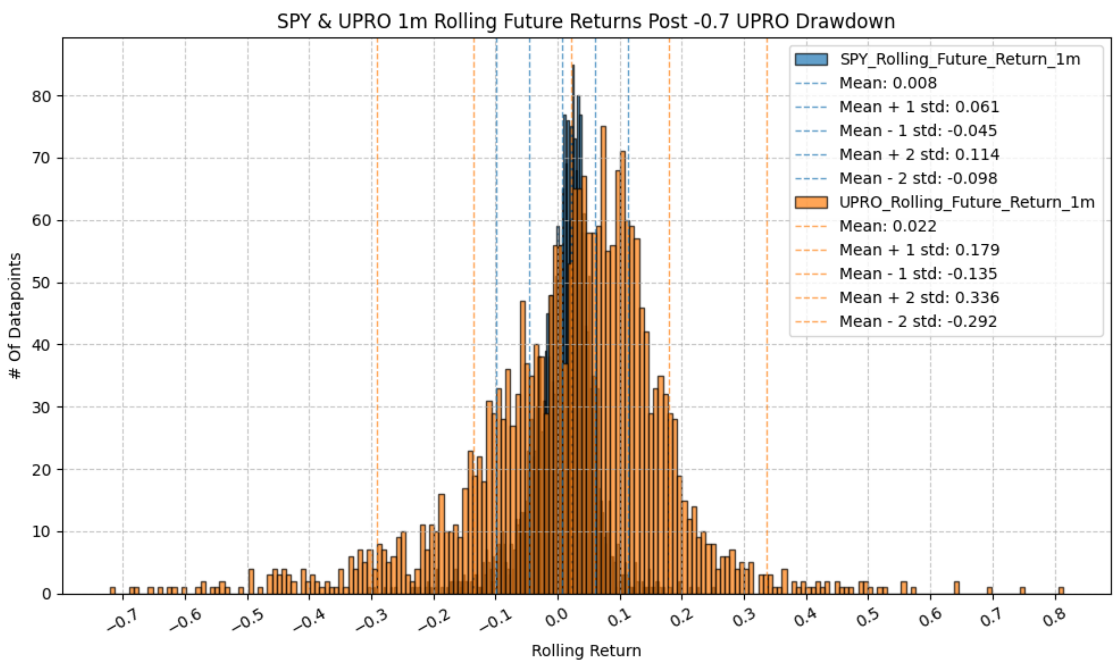
```
-7e-06        0.000
SPY_Rolling_Future_Return_1d     2.9779      0.003    868.238      0.000
2.971       2.985
==============================================================================
Omnibus:                     1557.902   Durbin-Watson:                   2.718
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           638251.842
Skew:                           1.869   Prob(JB):                         0.00
Kurtosis:                      83.393   Cond. No.                         70.0
==============================================================================

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

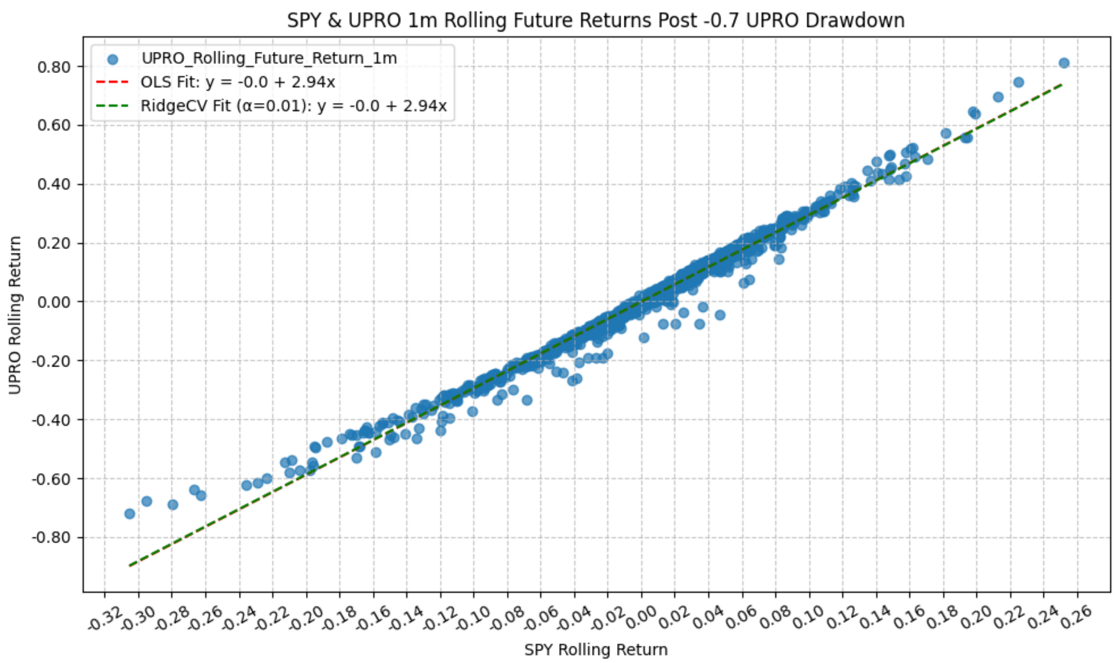





```
                                OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1w   R-squared:
0.991
Model:                                       OLS   Adj. R-squared:
0.991
Method:                            Least Squares   F-statistic:
2.714e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:19   Log-Likelihood:
8089.2
No. Observations:                           2365   AIC:
-1.617e+04
Df Residuals:                               2363   BIC:
-1.616e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                        -7.288e-05      0.000     -0.447      0.655
```

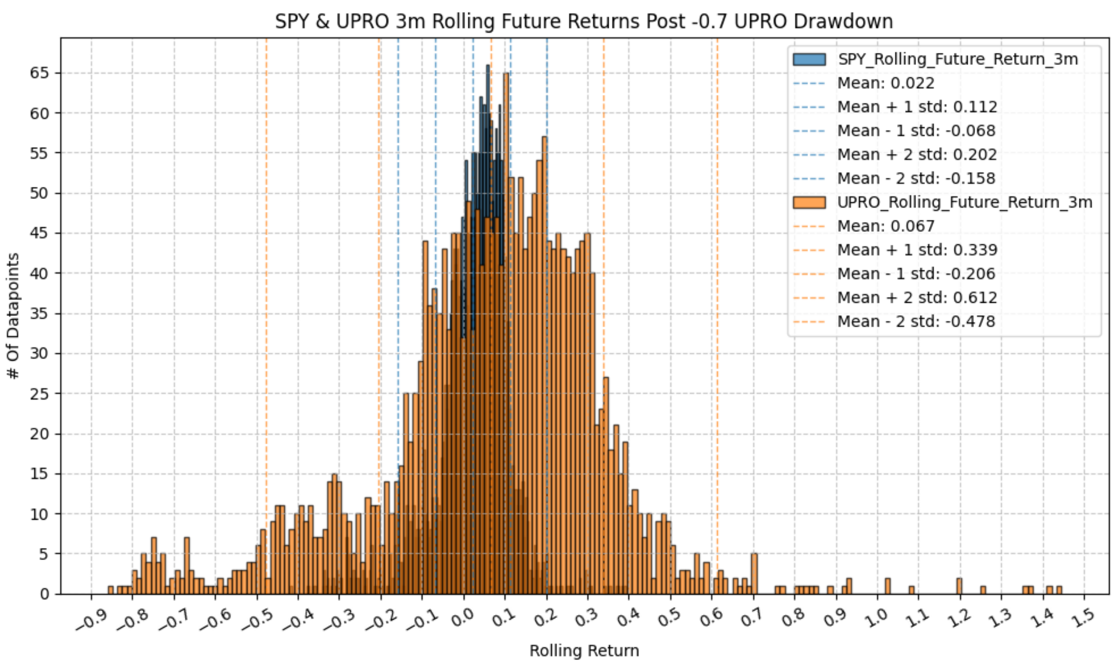
```
-0.000        0.000
SPY_Rolling_Future_Return_1w      2.9631       0.006     520.935       0.000
2.952       2.974
==============================================================================
Omnibus:                      893.424   Durbin-Watson:                   1.046
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           167543.096
Skew:                          -0.621   Prob(JB):                         0.00
Kurtosis:                      44.215   Cond. No.                         34.9
==============================================================================

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

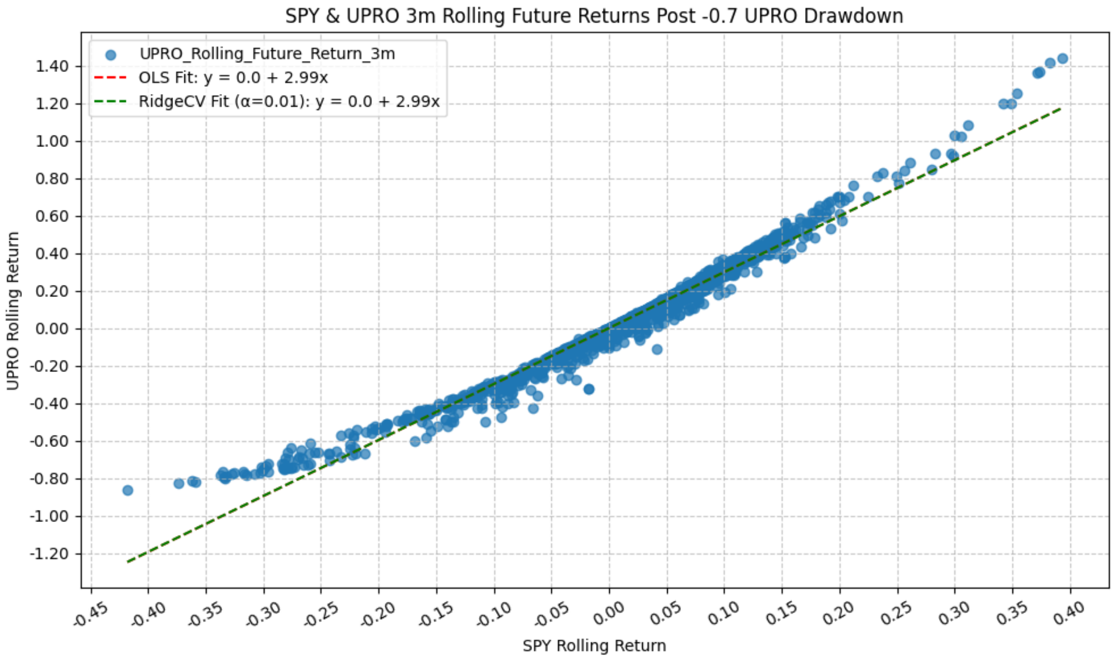





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1m   R-squared:
0.984
Model:                                       OLS   Adj. R-squared:
0.984
Method:                            Least Squares   F-statistic:
1.475e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:20   Log-Likelihood:
5932.1
No. Observations:                           2365   AIC:
-1.186e+04
Df Residuals:                               2363   BIC:
-1.185e+04
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0007      0.000     -1.733      0.083
```

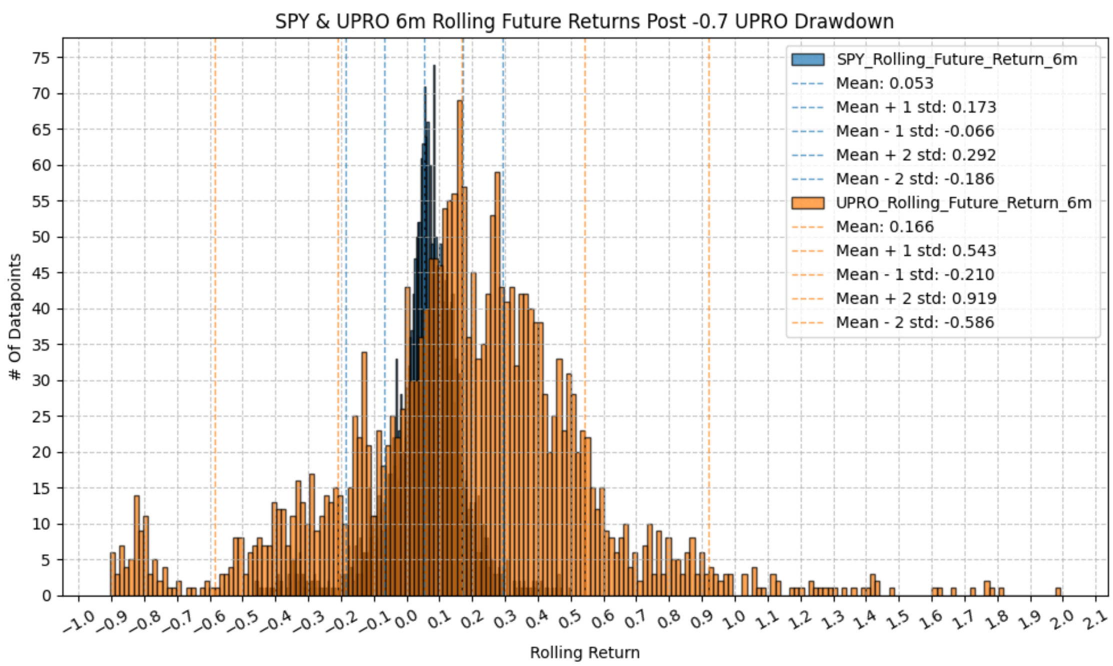
```
-0.002    9.34e-05
SPY_Rolling_Future_Return_1m     2.9414      0.008    384.053      0.000
2.926      2.956
==============================================================================
Omnibus:                      955.111   Durbin-Watson:                   0.364
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            63631.709
Skew:                          -1.056   Prob(JB):                         0.00
Kurtosis:                      28.323   Cond. No.                         18.9
==============================================================================

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

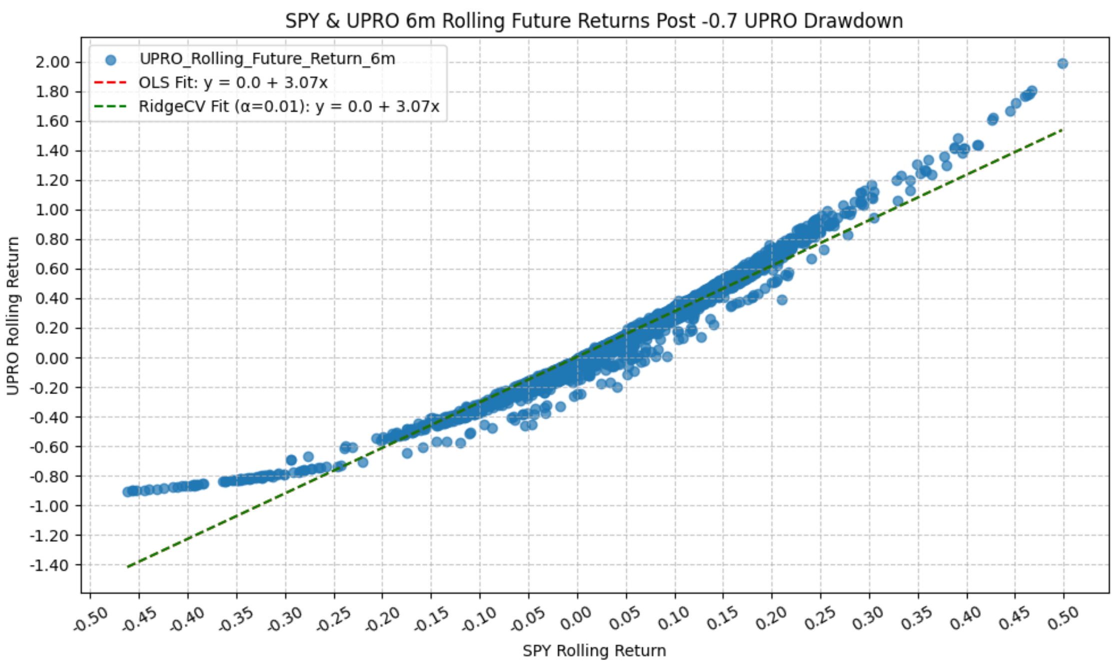





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3m   R-squared:
0.976
Model:                                       OLS   Adj. R-squared:
0.976
Method:                            Least Squares   F-statistic:
9.454e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:21   Log-Likelihood:
4110.7
No. Observations:                           2365   AIC:
-8217.
Df Residuals:                               2363   BIC:
-8206.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                            0.0012      0.001      1.374      0.170
```

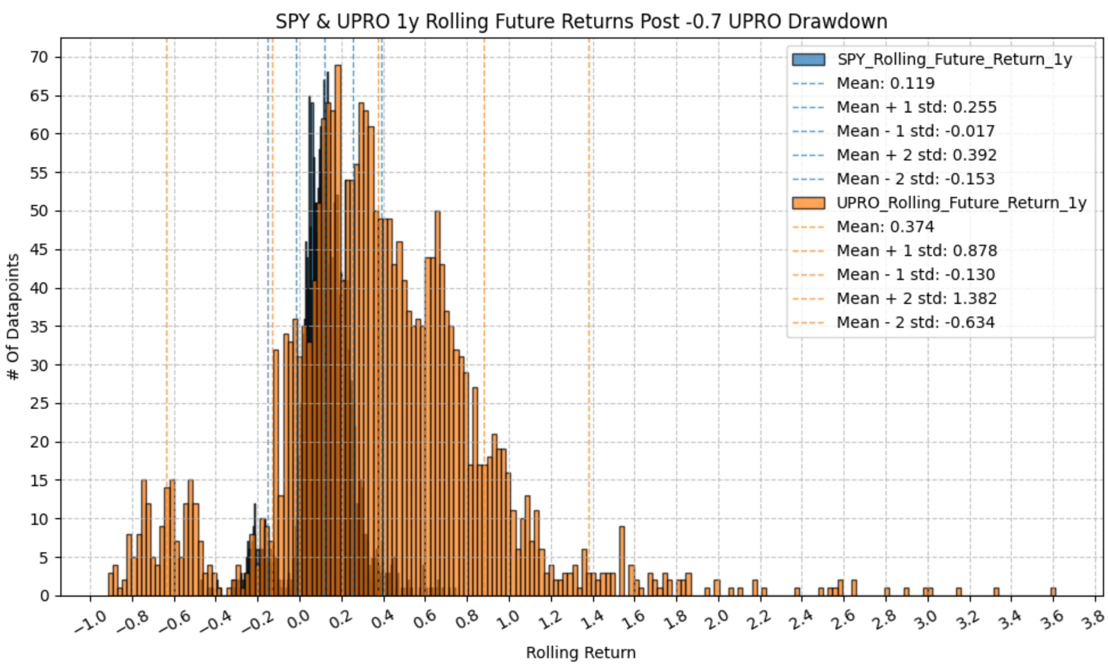
```
-0.001      0.003
SPY_Rolling_Future_Return_3m     2.9866      0.010    307.473      0.000
2.968      3.006
==============================================================================
Omnibus:                      813.503   Durbin-Watson:                   0.169
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            16781.750
Skew:                           1.111   Prob(JB):                         0.00
Kurtosis:                      15.859   Cond. No.                         11.1
==============================================================================

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

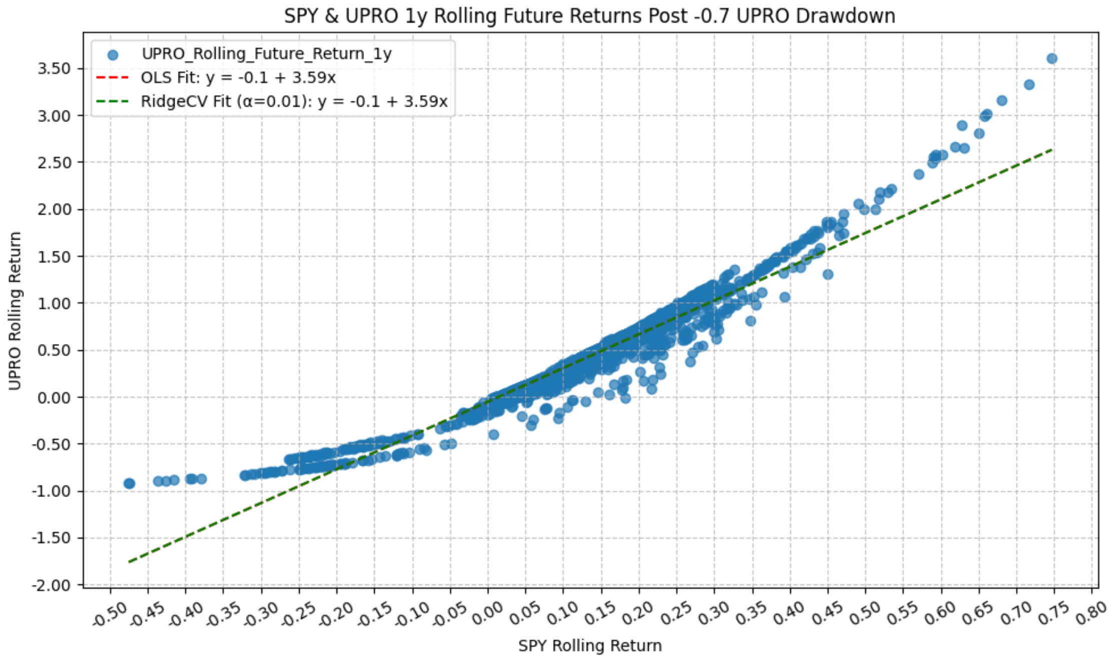





```
                                 OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_6m   R-squared:
0.954
Model:                                       OLS   Adj. R-squared:
0.954
Method:                            Least Squares   F-statistic:
4.945e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:23   Log-Likelihood:
2608.8
No. Observations:                           2365   AIC:
-5214.
Df Residuals:                               2363   BIC:
-5202.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                            0.0035      0.002      1.917      0.055
```

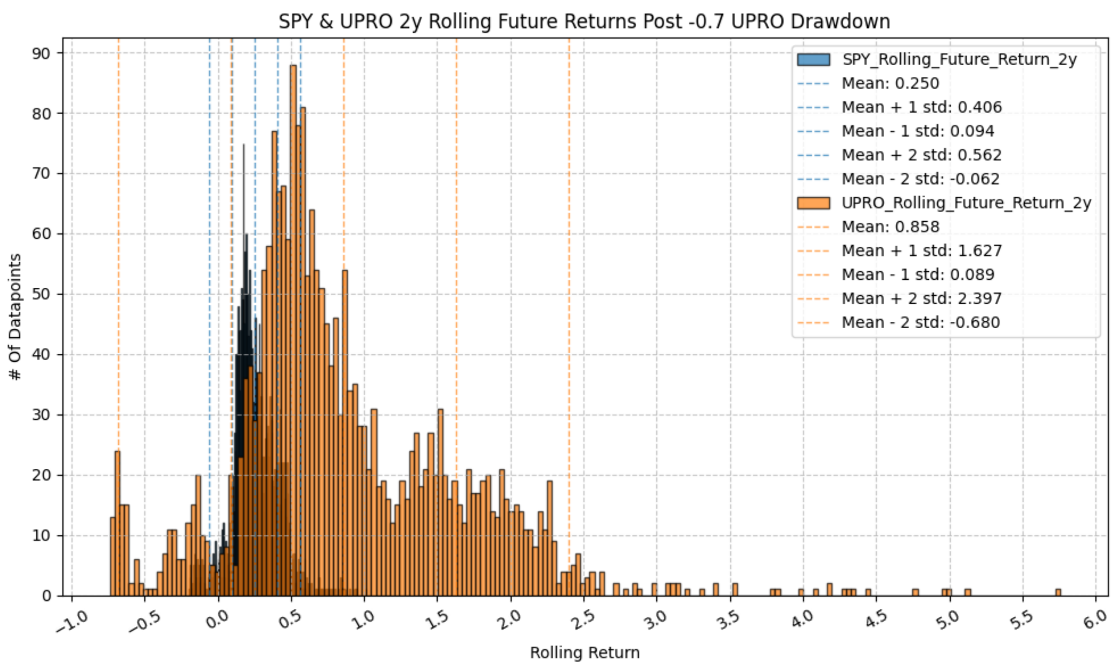
```
-7.96e-05       0.007
SPY_Rolling_Future_Return_6m      3.0747       0.014     222.381       0.000
3.048       3.102
==============================================================================
Omnibus:                      829.879   Durbin-Watson:                   0.069
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             7404.057
Skew:                           1.399   Prob(JB):                         0.00
Kurtosis:                      11.204   Cond. No.                         8.39
==============================================================================

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

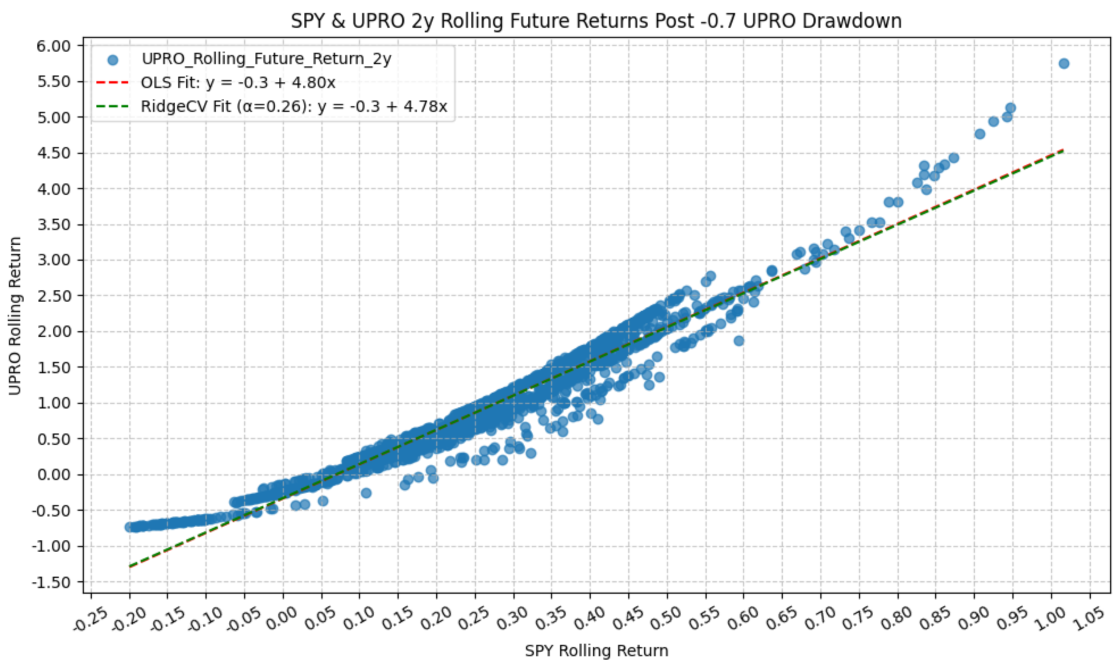





```
                                  OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1y   R-squared:
0.941
Model:                                       OLS   Adj. R-squared:
0.941
Method:                            Least Squares   F-statistic:
3.754e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:24   Log-Likelihood:
1607.4
No. Observations:                           2365   AIC:
-3211.
Df Residuals:                               2363   BIC:
-3199.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0550      0.003    -16.382      0.000
```

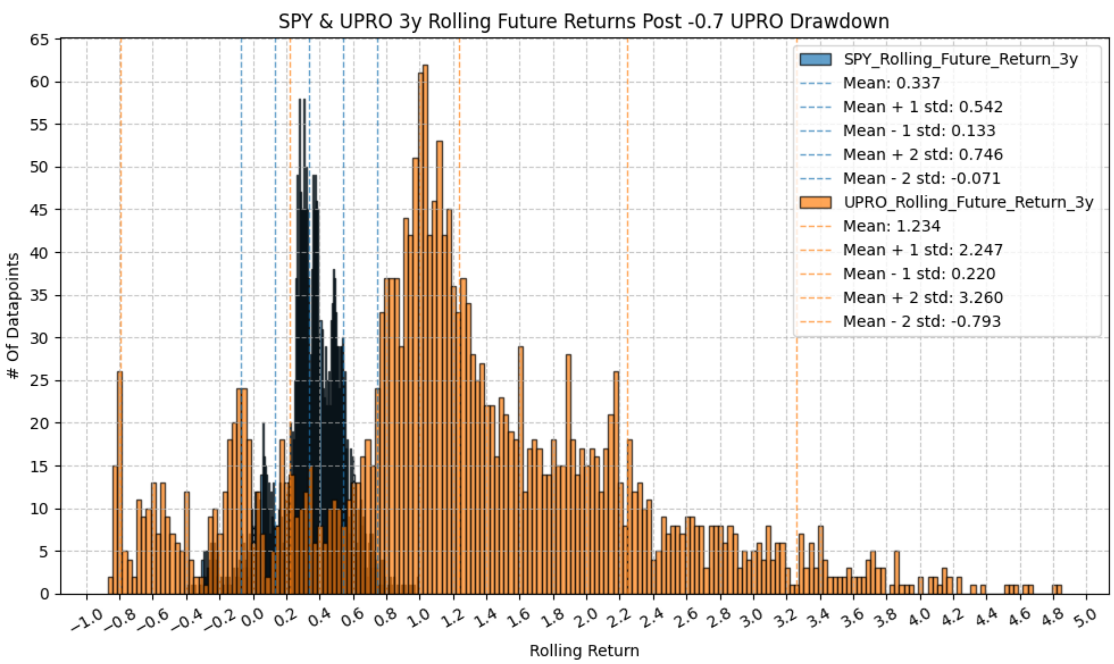
```
-0.062      -0.048
SPY_Rolling_Future_Return_1y     3.5929      0.019    193.749      0.000
3.556       3.629
==============================================================================
Omnibus:                      724.737   Durbin-Watson:                   0.076
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            11317.549
Skew:                           1.017   Prob(JB):                         0.00
Kurtosis:                      13.522   Cond. No.                         7.46
==============================================================================

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

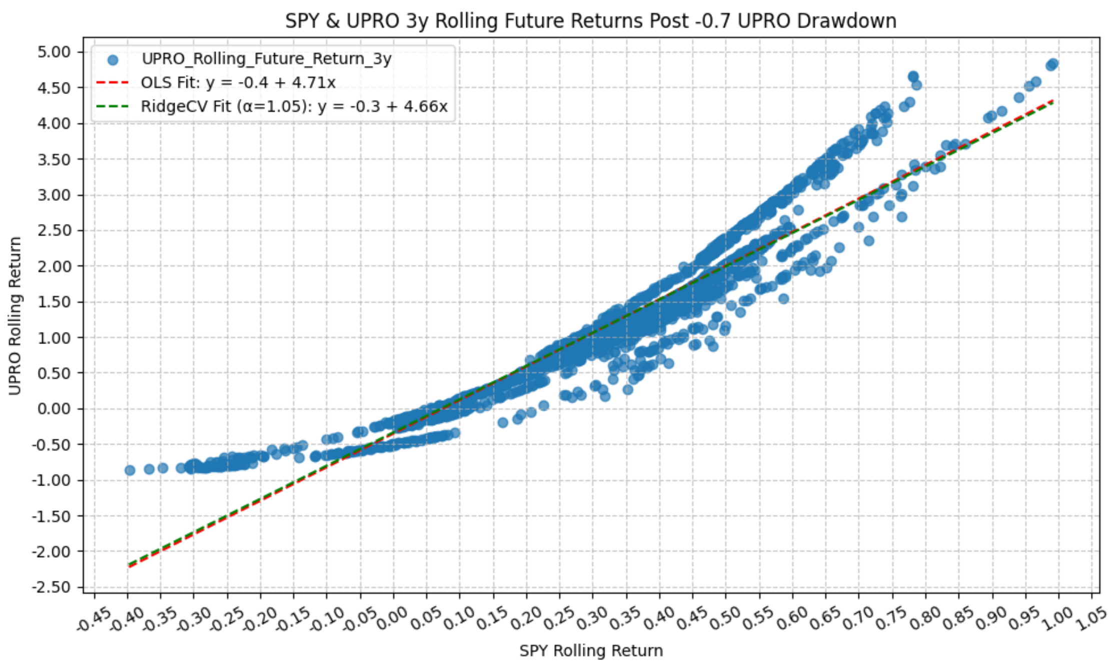





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_2y   R-squared:
0.947
Model:                                       OLS   Adj. R-squared:
0.947
Method:                            Least Squares   F-statistic:
4.184e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:25   Log-Likelihood:
728.41
No. Observations:                           2365   AIC:
-1453.
Df Residuals:                               2363   BIC:
-1441.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
 [0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.3422      0.007    -49.482      0.000
```

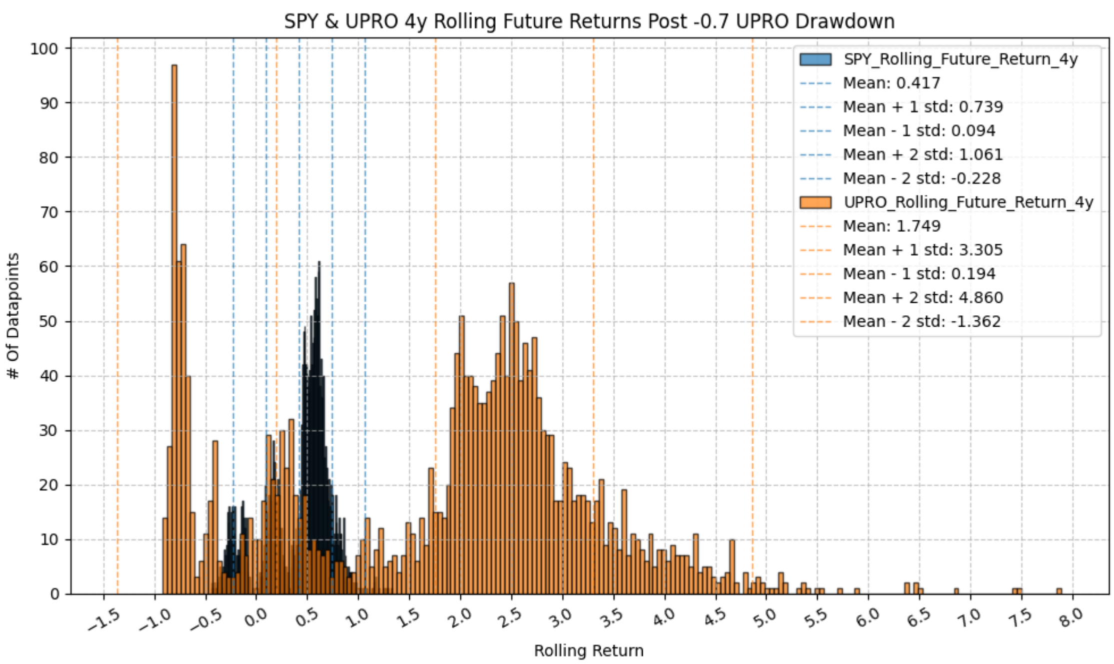
```
-0.356      -0.329
SPY_Rolling_Future_Return_2y     4.7992      0.023    204.538      0.000
4.753       4.845
==============================================================================
Omnibus:                      261.292   Durbin-Watson:                   0.050
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1788.713
Skew:                          -0.271   Prob(JB):                         0.00
Kurtosis:                       7.226   Cond. No.                         6.82
==============================================================================

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

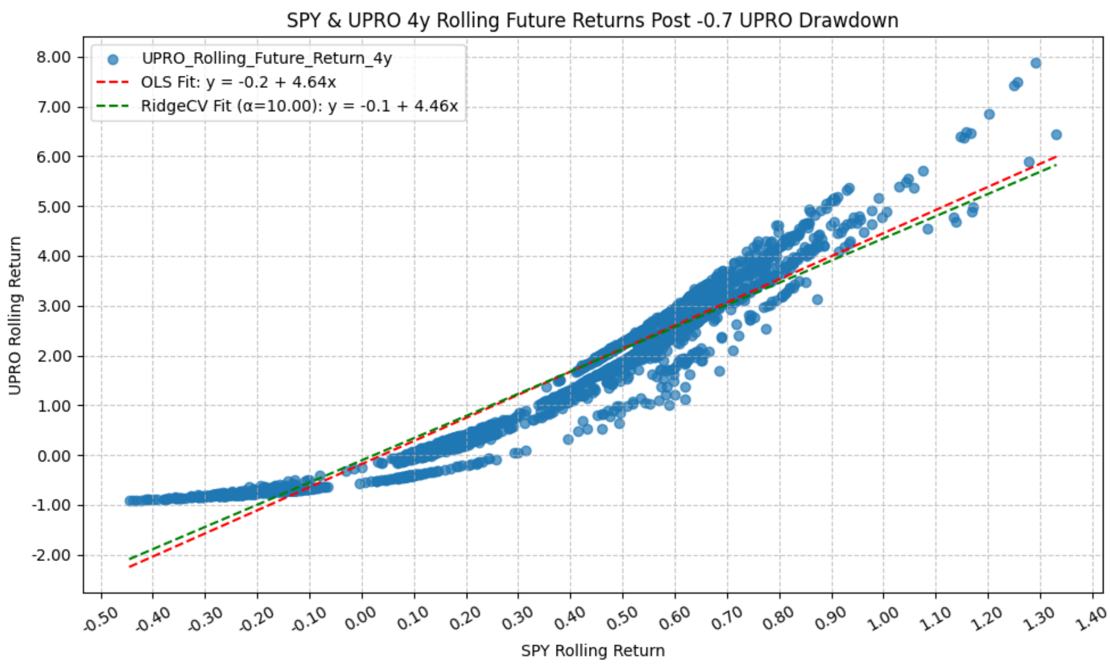





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3y   R-squared:
0.901
Model:                                       OLS   Adj. R-squared:
0.901
Method:                            Least Squares   F-statistic:
2.158e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:26   Log-Likelihood:
-648.58
No. Observations:                           2365   AIC:
1301.
Df Residuals:                               2363   BIC:
1313.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.3554      0.013    -28.107      0.000
```

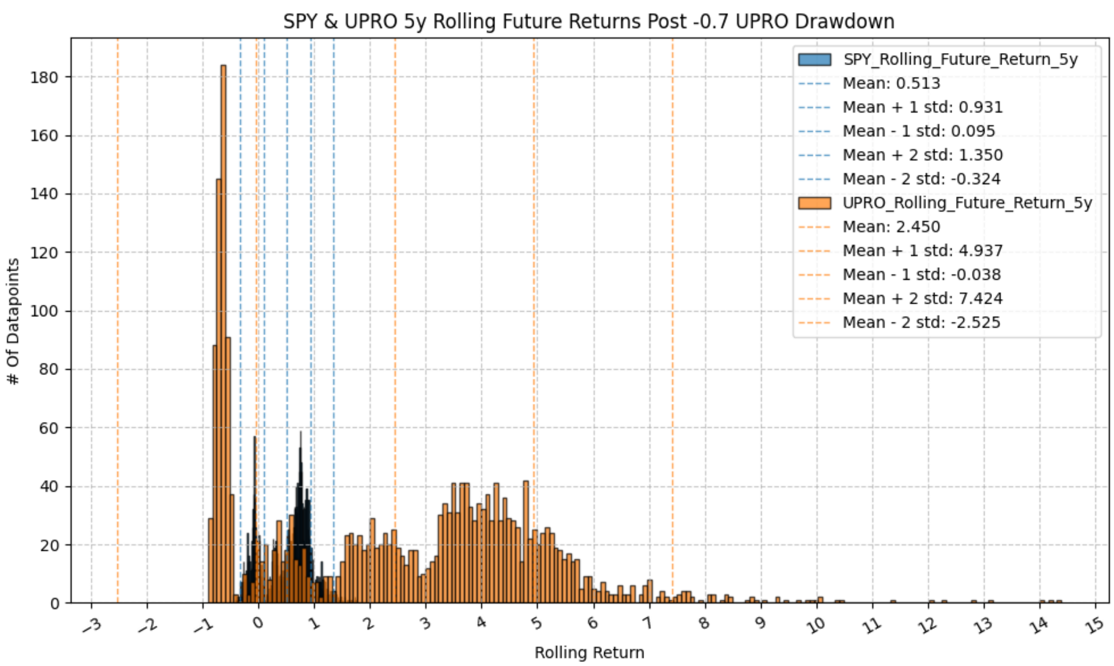
```
-0.380      -0.331
SPY_Rolling_Future_Return_3y     4.7081      0.032    146.886      0.000
4.645       4.771
==============================================================================
Omnibus:                      350.033   Durbin-Watson:                   0.028
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              725.274
Skew:                           0.885   Prob(JB):                    3.23e-158
Kurtosis:                       5.057   Cond. No.                         5.47
==============================================================================

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

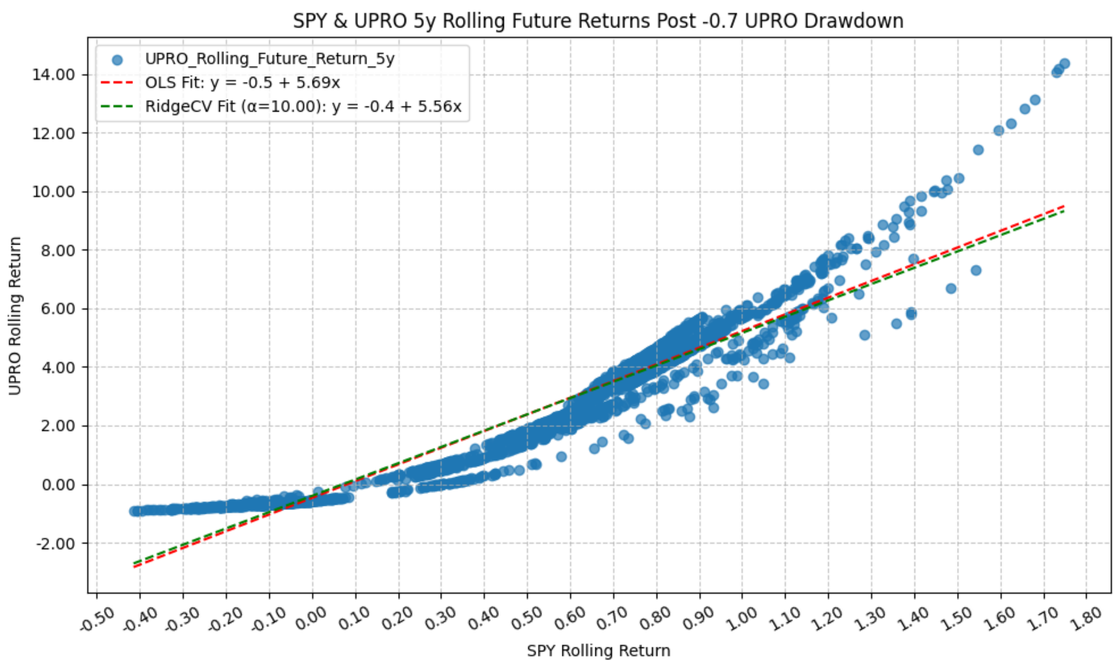





```
                                   OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_4y   R-squared:
0.925
Model:                                       OLS   Adj. R-squared:
0.925
Method:                            Least Squares   F-statistic:
2.909e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:27   Log-Likelihood:
-1339.2
No. Observations:                           2365   AIC:
2682.
Df Residuals:                               2363   BIC:
2694.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.1851      0.014    -12.912      0.000
```

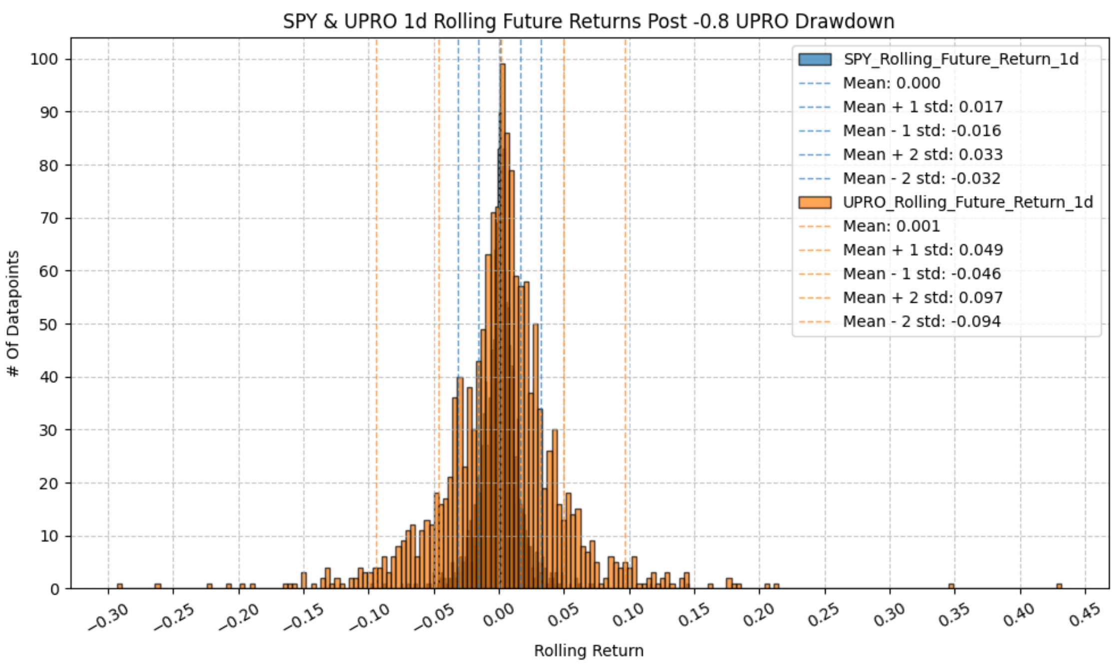
```
-0.213      -0.157
SPY_Rolling_Future_Return_4y     4.6425      0.027    170.565      0.000
4.589       4.696
==============================================================================
Omnibus:                       55.496   Durbin-Watson:                   0.030
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              118.356
Skew:                           0.081   Prob(JB):                     1.99e-26
Kurtosis:                       4.084   Cond. No.                         3.69
==============================================================================

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

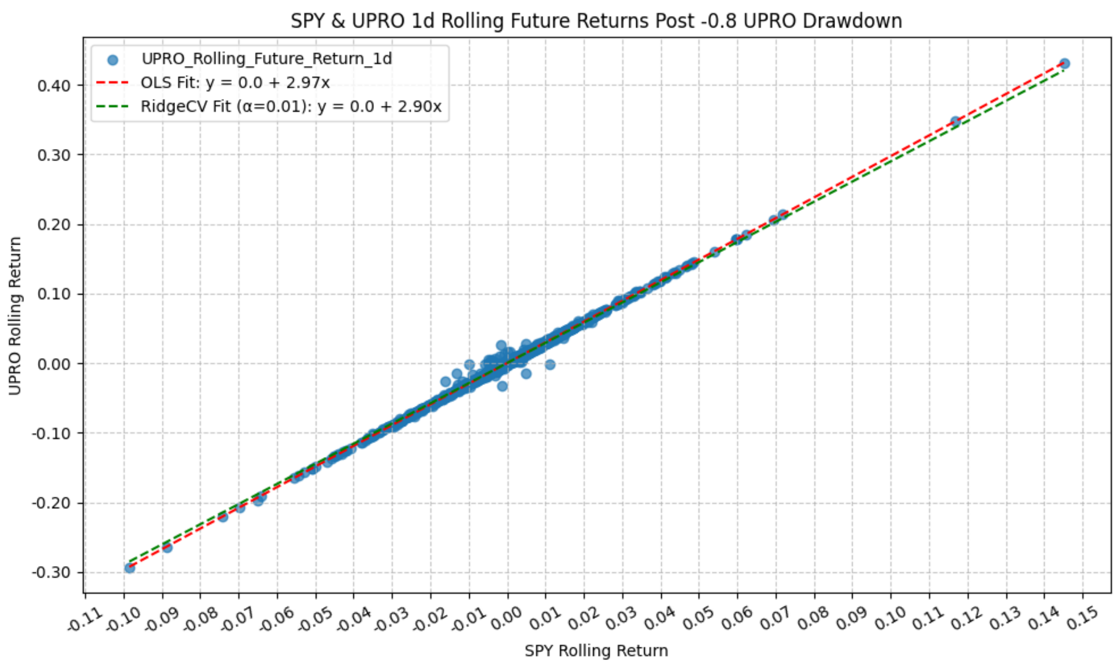





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_5y   R-squared:
0.917
Model:                                       OLS   Adj. R-squared:
0.917
Method:                            Least Squares   F-statistic:
2.615e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:28   Log-Likelihood:
-2565.1
No. Observations:                           2365   AIC:
5134.
Df Residuals:                               2363   BIC:
5146.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.4704      0.023    -20.191      0.000
```

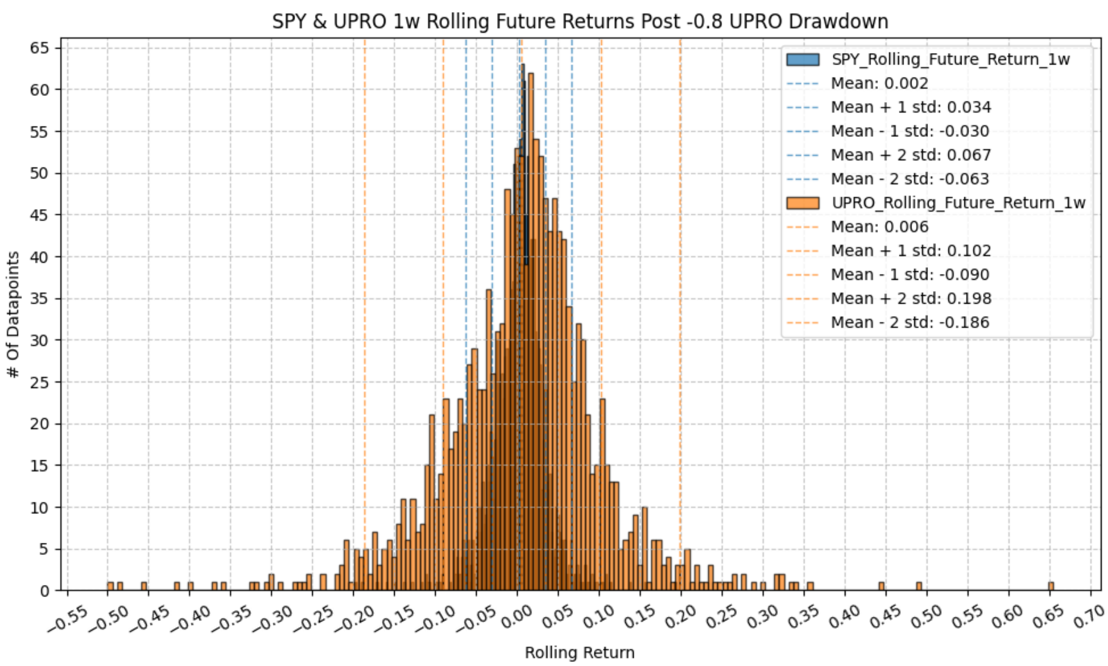
```
-0.516      -0.425
SPY_Rolling_Future_Return_5y      5.6929      0.035     161.723      0.000
5.624       5.762
==============================================================================
Omnibus:                      311.086   Durbin-Watson:                   0.028
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1363.041
Skew:                           0.566   Prob(JB):                   1.05e-296
Kurtosis:                       6.543   Cond. No.                         3.12
==============================================================================

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

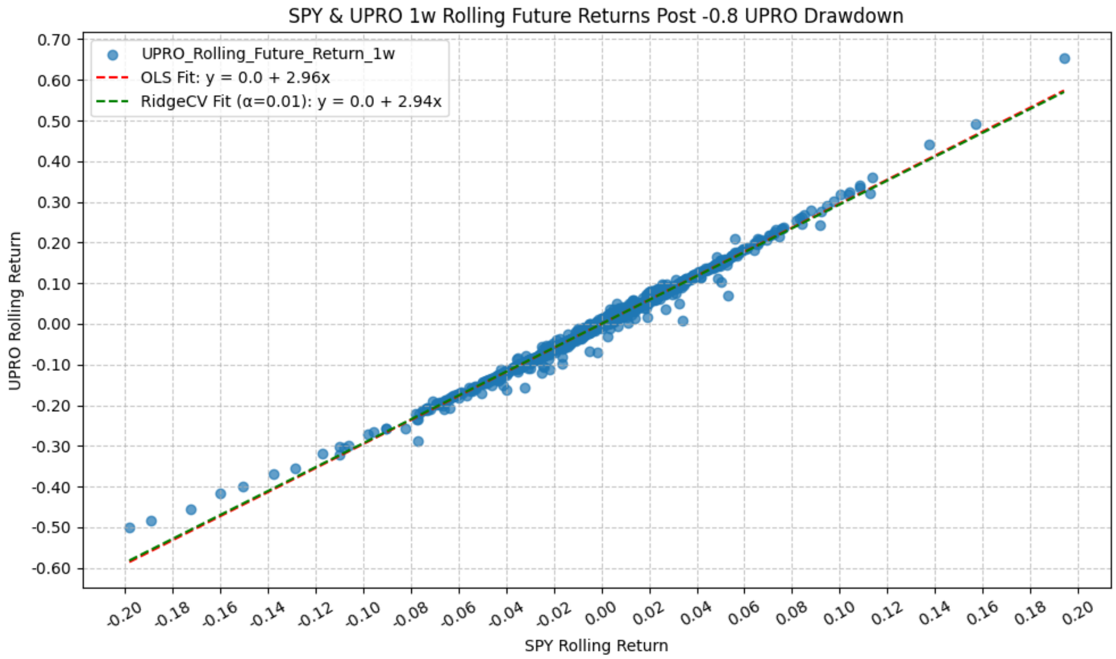





```
                                 OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1d   R-squared:
0.997
Model:                                       OLS   Adj. R-squared:
0.997
Method:                            Least Squares   F-statistic:
4.362e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:29   Log-Likelihood:
6607.2
No. Observations:                           1479   AIC:
-1.321e+04
Df Residuals:                               1477   BIC:
-1.320e+04
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                            0.0001   7.23e-05      1.550      0.121
```

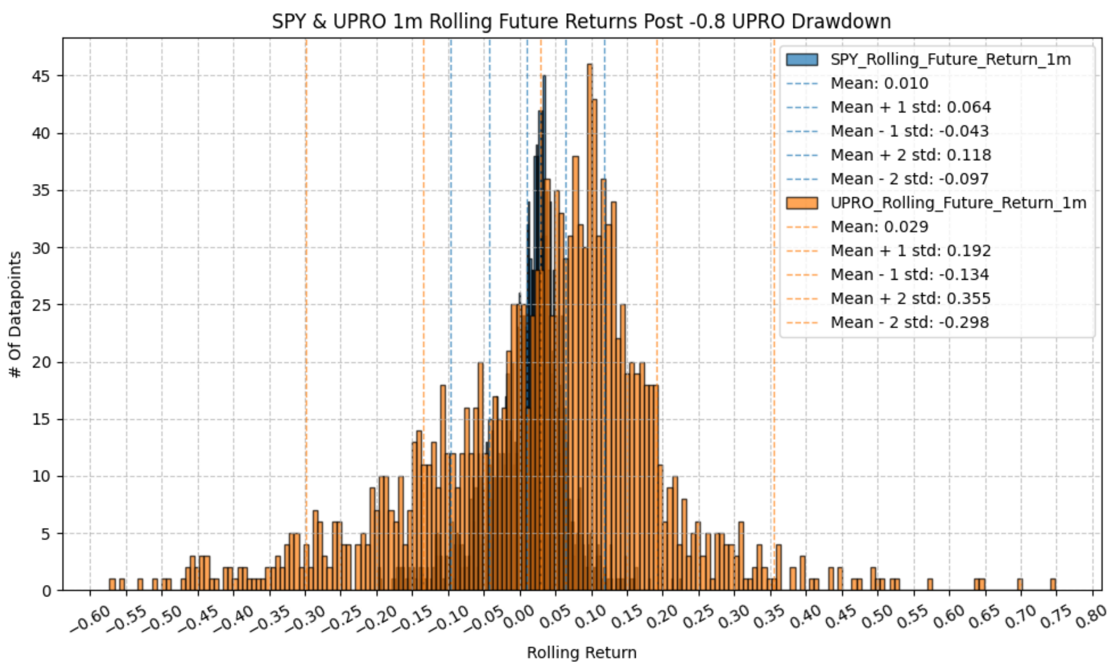
```
-2.98e-05         0.000
SPY_Rolling_Future_Return_1d      2.9736       0.005     660.468       0.000
2.965        2.982
==============================================================================
Omnibus:                      759.528   Durbin-Watson:                   2.689
Prob(Omnibus):                  0.000   Jarque-Bera (JB):           237908.791
Skew:                           1.142   Prob(JB):                         0.00
Kurtosis:                      65.092   Cond. No.                         62.3
==============================================================================

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

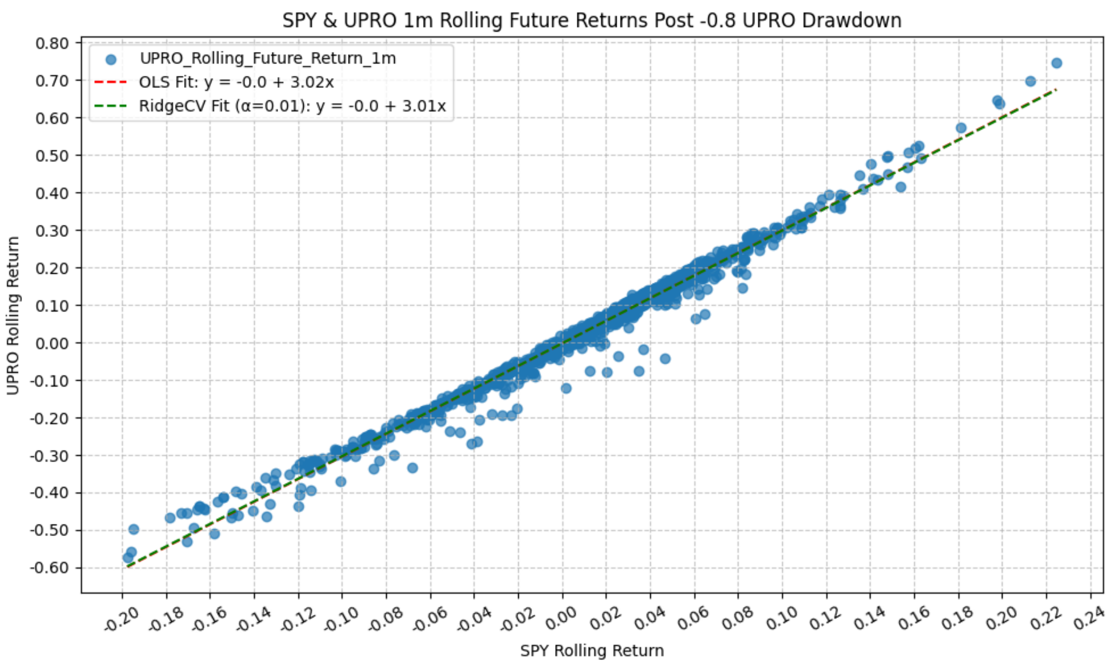





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1w   R-squared:
0.990
Model:                                       OLS   Adj. R-squared:
0.990
Method:                            Least Squares   F-statistic:
1.475e+05
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:31   Log-Likelihood:
4779.3
No. Observations:                           1479   AIC:
-9555.
Df Residuals:                               1477   BIC:
-9544.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                              coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                    3.196e-06      0.000      0.013      0.990
```

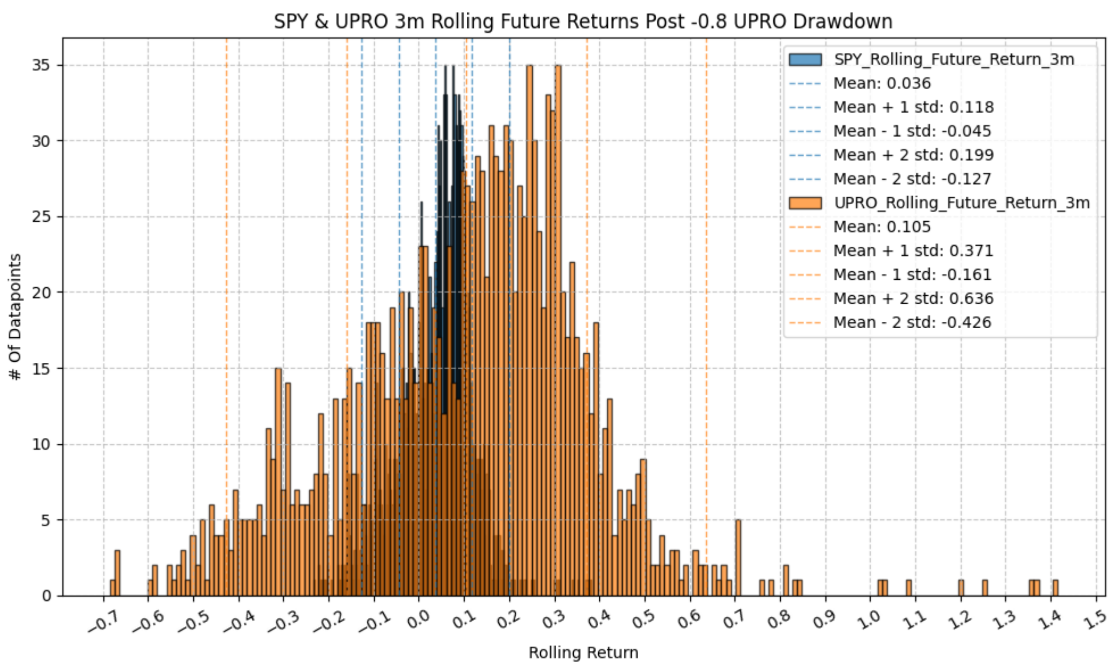
```
-0.000      0.000
SPY_Rolling_Future_Return_1w     2.9572      0.008    384.014      0.000
2.942       2.972
==============================================================================
Omnibus:                      517.977   Durbin-Watson:                   1.023
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            52657.085
Skew:                          -0.625   Prob(JB):                         0.00
Kurtosis:                      32.205   Cond. No.                         31.0
==============================================================================

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

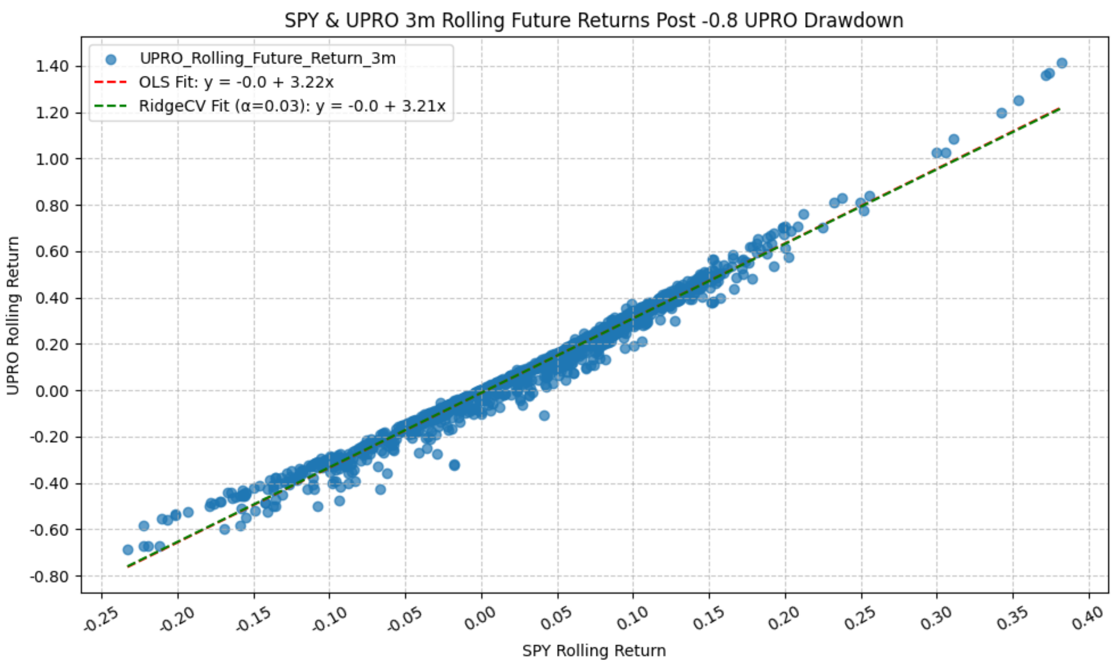





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1m   R-squared:
0.983
Model:                                       OLS   Adj. R-squared:
0.983
Method:                            Least Squares   F-statistic:
8.452e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:32   Log-Likelihood:
3588.8
No. Observations:                           1479   AIC:
-7174.
Df Residuals:                               1477   BIC:
-7163.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.0029      0.001     -5.075      0.000
```

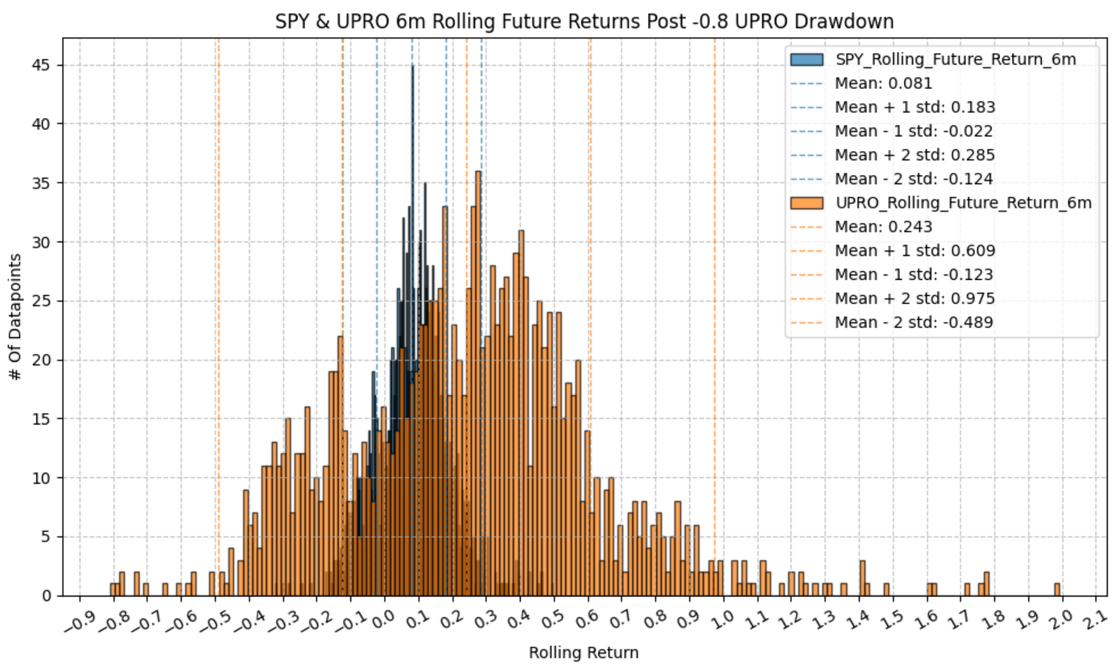
```
-0.004      -0.002
SPY_Rolling_Future_Return_1m     3.0167      0.010    290.718      0.000
2.996       3.037
==============================================================================
Omnibus:                      951.943   Durbin-Watson:                   0.291
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            19753.591
Skew:                          -2.649   Prob(JB):                         0.00
Kurtosis:                      20.102   Cond. No.                         18.7
==============================================================================

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

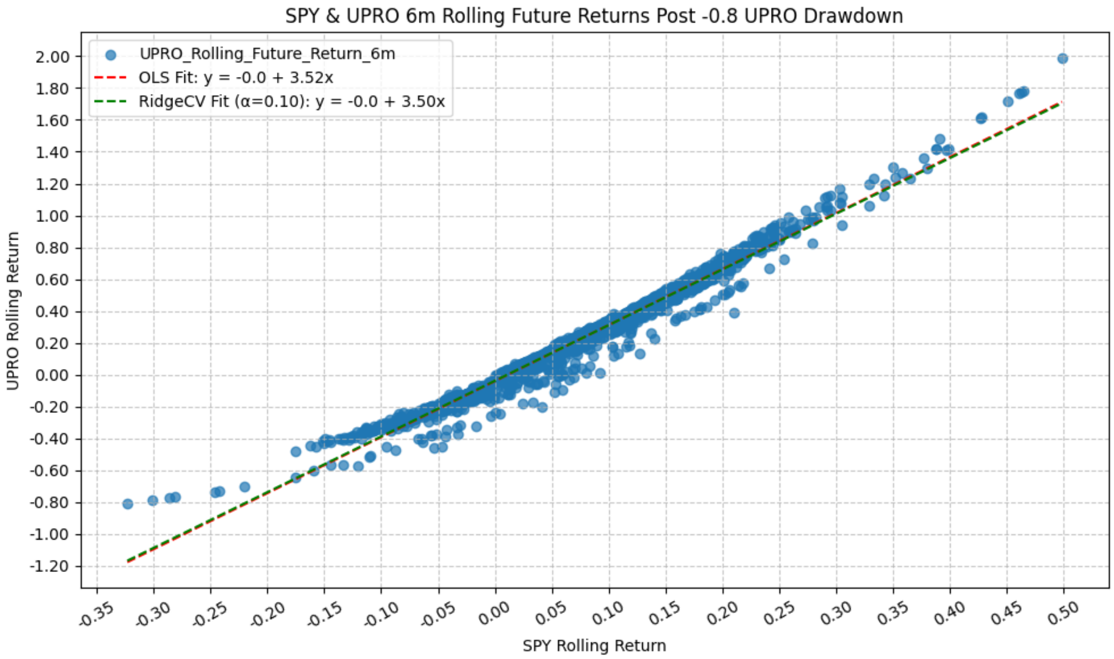





```
                                    OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3m   R-squared:
0.980
Model:                                       OLS   Adj. R-squared:
0.980
Method:                            Least Squares   F-statistic:
7.182e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:33   Log-Likelihood:
2749.5
No. Observations:                           1479   AIC:
-5495.
Df Residuals:                               1477   BIC:
-5484.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0120      0.001    -11.210      0.000
```

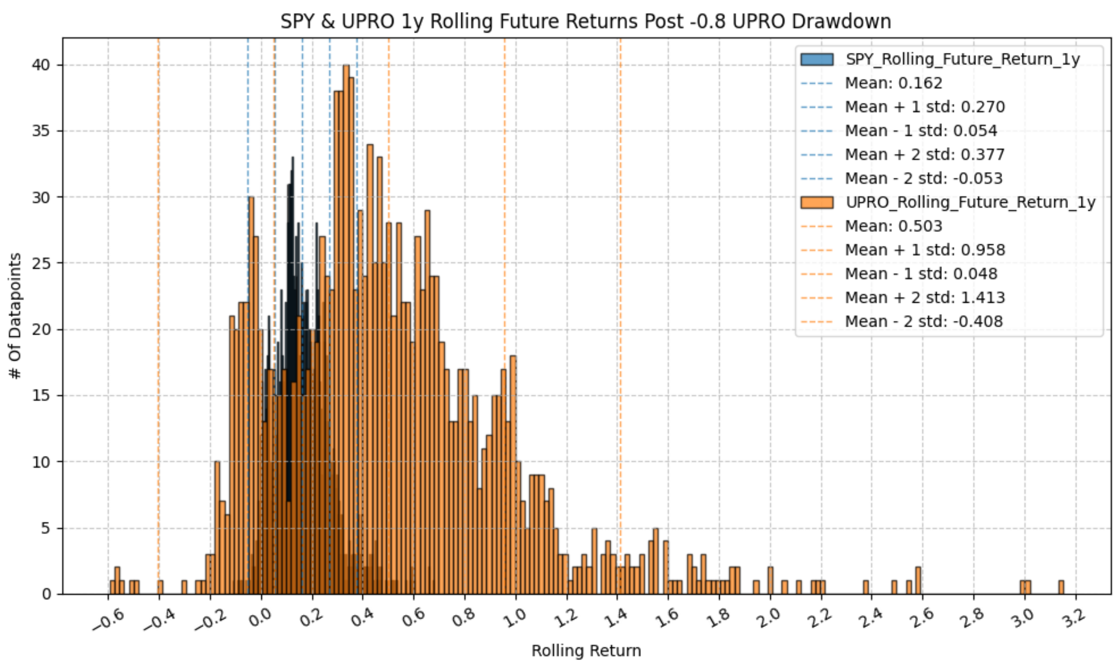
```
-0.014      -0.010
SPY_Rolling_Future_Return_3m     3.2239      0.012    267.983      0.000
3.200       3.248
==============================================================================
Omnibus:                      396.774   Durbin-Watson:                   0.203
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             3170.391
Skew:                          -1.021   Prob(JB):                         0.00
Kurtosis:                       9.876   Cond. No.                         12.3
==============================================================================

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

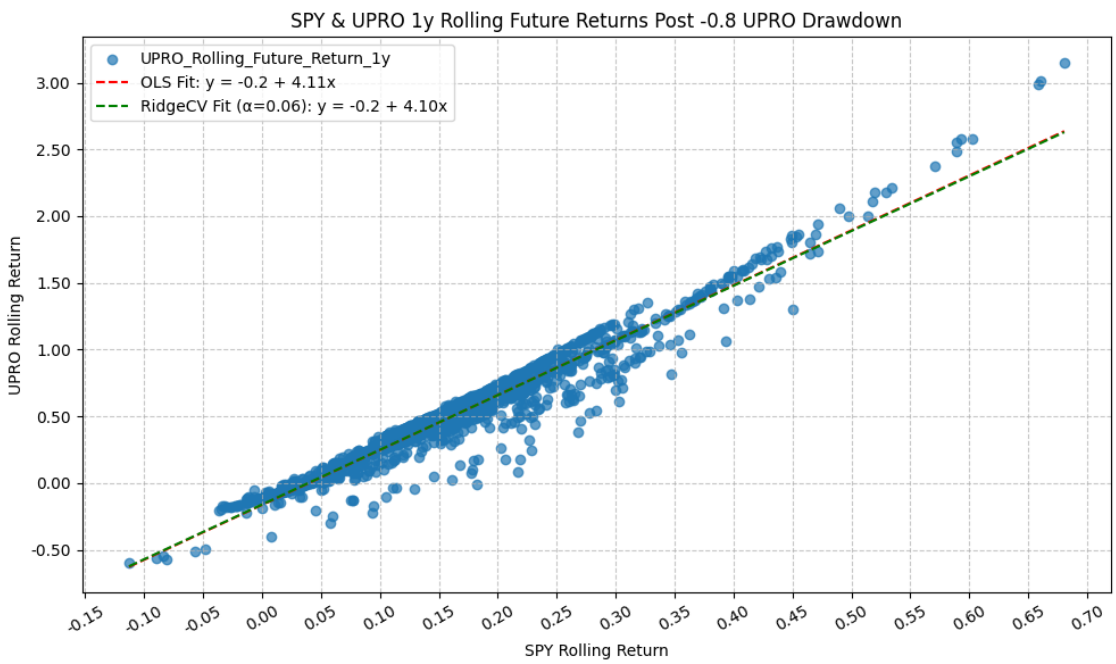





```
                                 OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_6m   R-squared:
0.971
Model:                                       OLS   Adj. R-squared:
0.971
Method:                            Least Squares   F-statistic:
4.873e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:34   Log-Likelihood:
1996.2
No. Observations:                           1479   AIC:
-3988.
Df Residuals:                               1477   BIC:
-3978.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -0.0410      0.002    -19.752      0.000
```

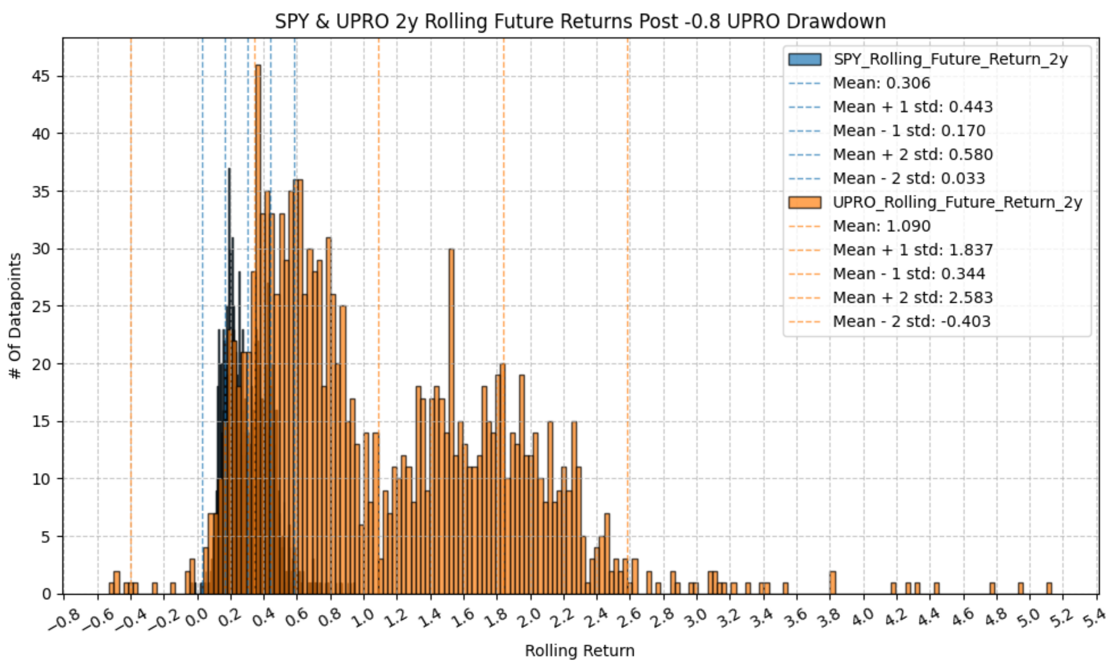
```
-0.045      -0.037
SPY_Rolling_Future_Return_6m     3.5211      0.016     220.756      0.000
3.490       3.552
==============================================================================
Omnibus:                      303.529   Durbin-Watson:                   0.139
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1799.504
Skew:                          -0.818   Prob(JB):                         0.00
Kurtosis:                       8.150   Cond. No.                         9.83
==============================================================================

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

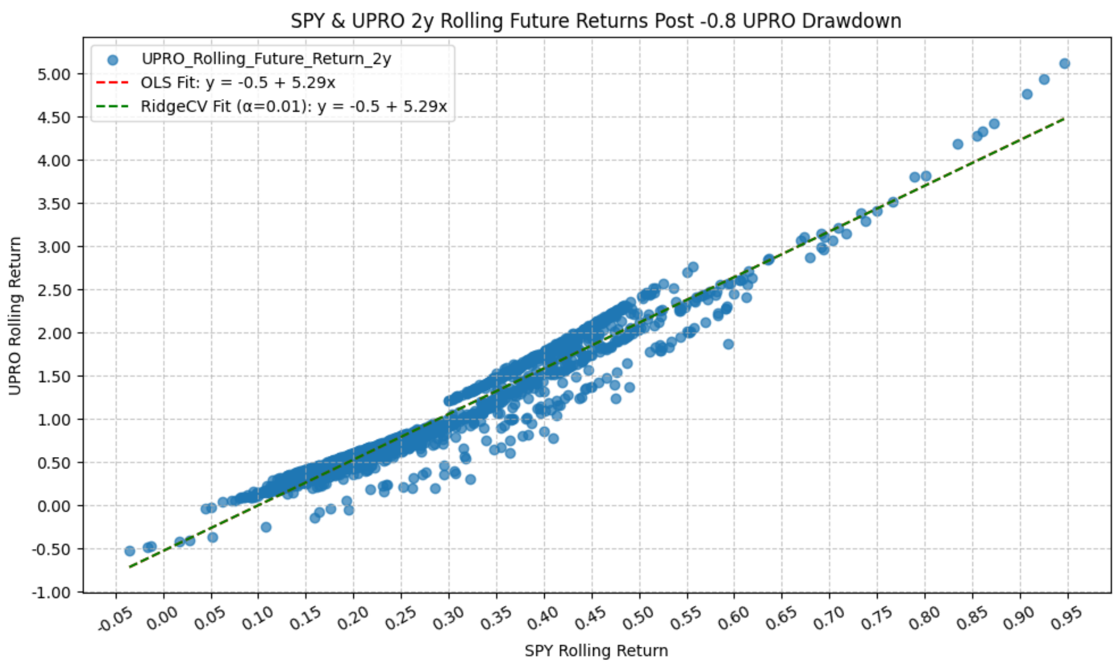





```
                            OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_1y   R-squared:
0.945
Model:                                       OLS   Adj. R-squared:
0.945
Method:                            Least Squares   F-statistic:
2.531e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:35   Log-Likelihood:
1208.7
No. Observations:                           1479   AIC:
-2413.
Df Residuals:                               1477   BIC:
-2403.
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                           -0.1638      0.005    -32.562      0.000
```

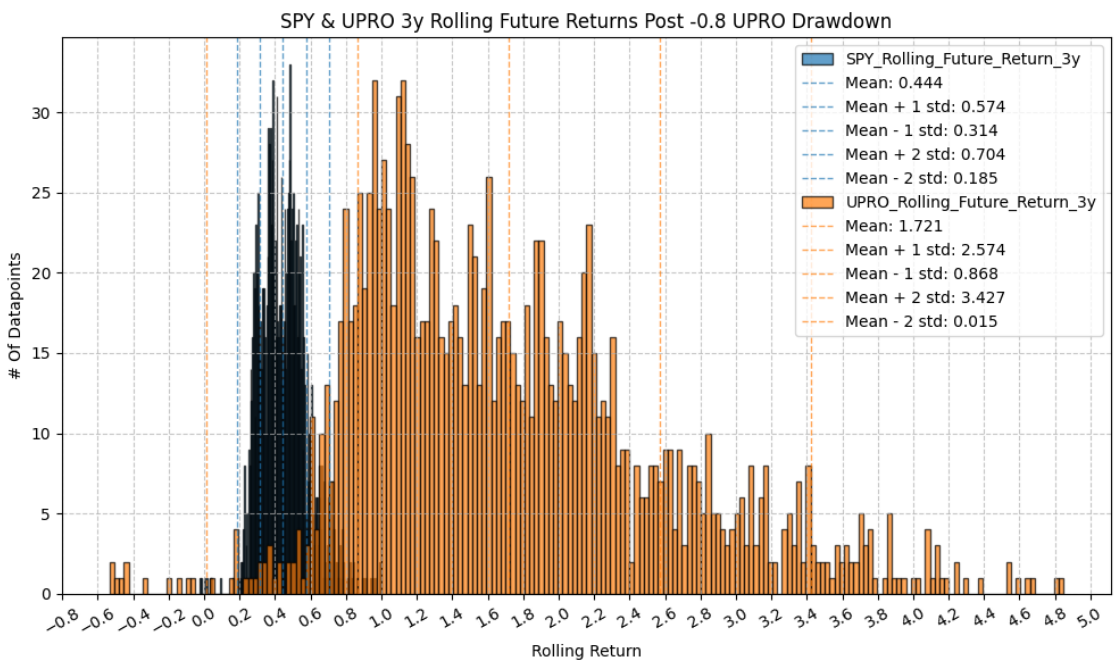
```
-0.174      -0.154
SPY_Rolling_Future_Return_1y     4.1149      0.026    159.078      0.000
4.064       4.166
==============================================================================
Omnibus:                      636.693   Durbin-Watson:                   0.055
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             4021.716
Skew:                          -1.901   Prob(JB):                         0.00
Kurtosis:                      10.128   Cond. No.                         9.55
==============================================================================

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

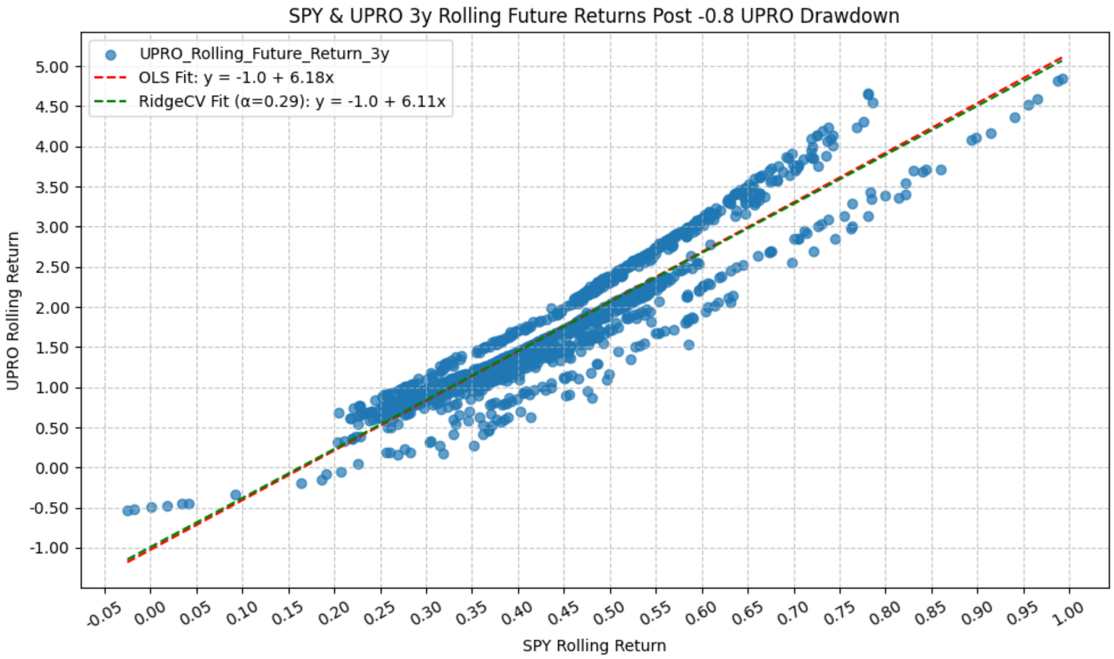





```
                                OLS Regression Results
===============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_2y   R-squared:
0.940
Model:                                       OLS   Adj. R-squared:
0.940
Method:                            Least Squares   F-statistic:
2.322e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:36   Log-Likelihood:
417.22
No. Observations:                           1479   AIC:
-830.4
Df Residuals:                               1477   BIC:
-819.8
Df Model:                                      1
Covariance Type:                       nonrobust
===============================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
-------------------------------------------------------------------------------
----------------
const                           -0.5307      0.012    -45.553      0.000
```

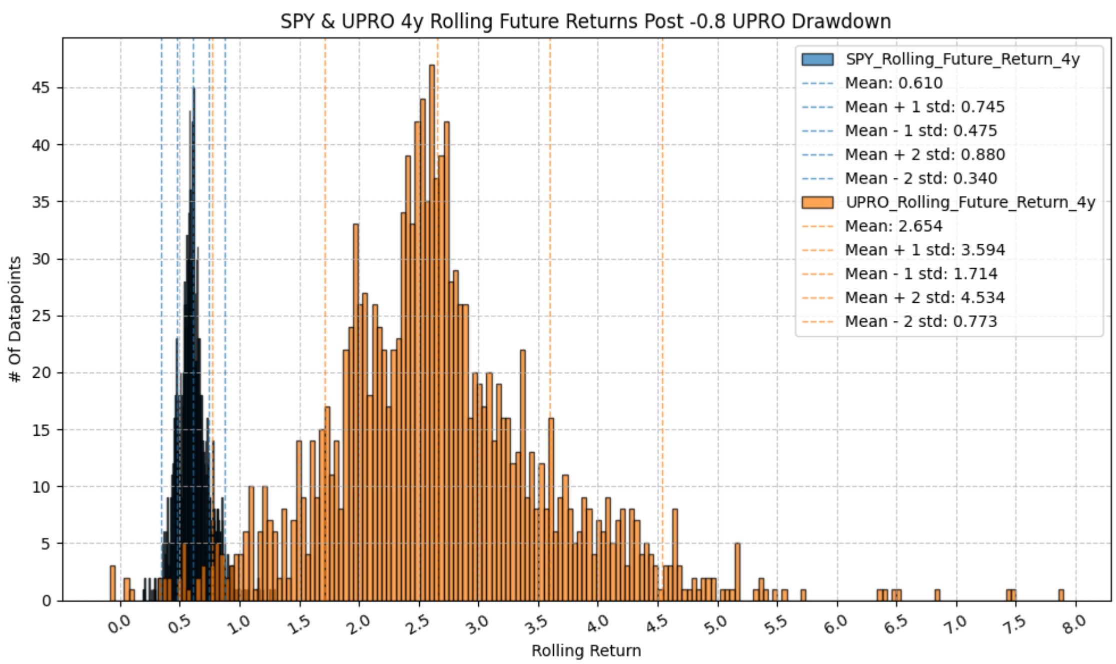
```
-0.554      -0.508
SPY_Rolling_Future_Return_2y      5.2906      0.035    152.380      0.000
5.222       5.359
==============================================================================
Omnibus:                      350.739   Durbin-Watson:                   0.045
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              917.233
Skew:                          -1.244   Prob(JB):                    6.69e-200
Kurtosis:                       5.949   Cond. No.                         8.01
==============================================================================

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

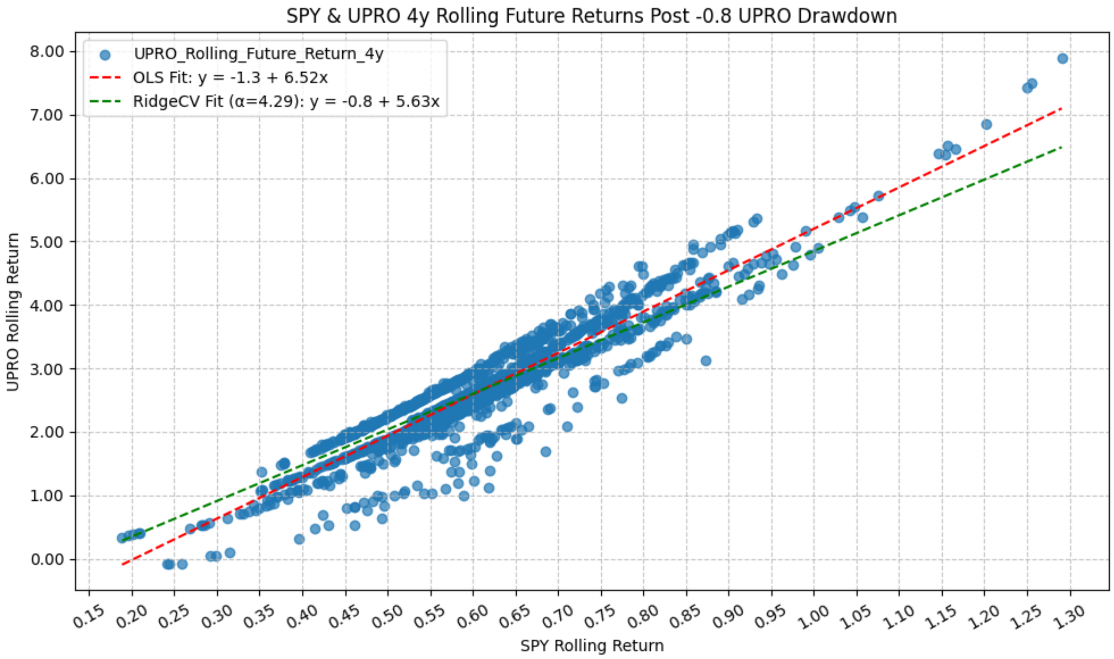





```
                              OLS Regression Results
==============================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_3y   R-squared:
0.884
Model:                                       OLS   Adj. R-squared:
0.884
Method:                            Least Squares   F-statistic:
1.128e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:37   Log-Likelihood:
-268.54
No. Observations:                           1479   AIC:
541.1
Df Residuals:                               1477   BIC:
551.7
Df Model:                                      1
Covariance Type:                       nonrobust
==============================================================================
================
                                  coef    std err          t      P>|t|
[0.025      0.975]
------------------------------------------------------------------------------
----------------
const                          -1.0243      0.027    -38.038      0.000
```

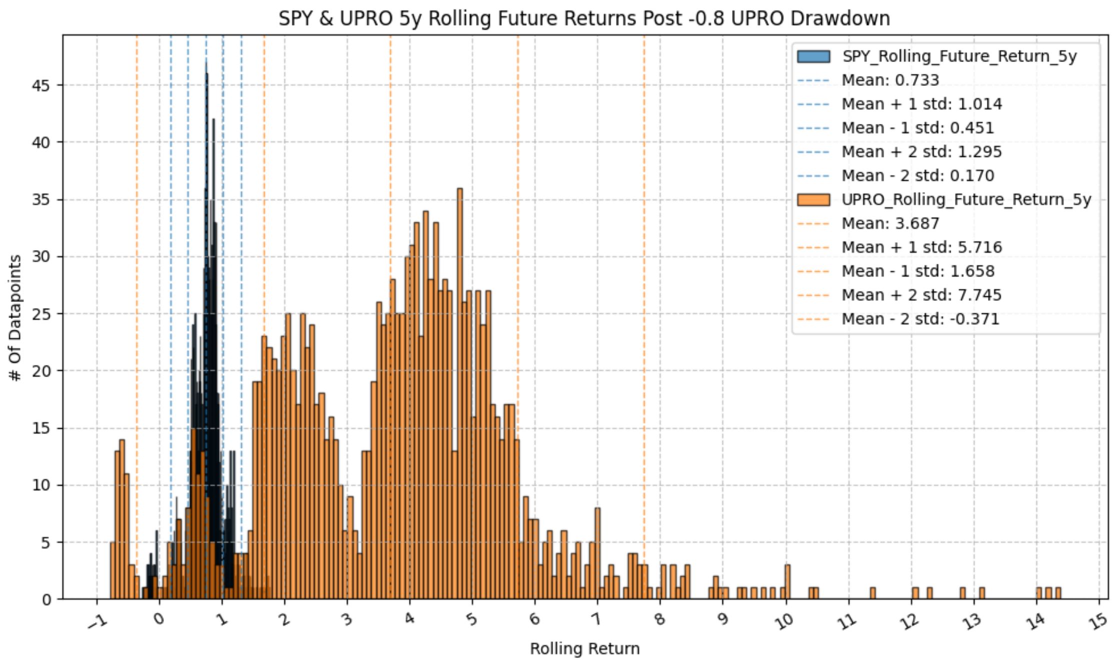
```
-1.077      -0.972
SPY_Rolling_Future_Return_3y     6.1791      0.058    106.196      0.000
6.065       6.293
==============================================================================
Omnibus:                       74.636   Durbin-Watson:                   0.032
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               91.011
Skew:                          -0.512   Prob(JB):                     1.73e-20
Kurtosis:                       3.655   Cond. No.                         9.25
==============================================================================

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

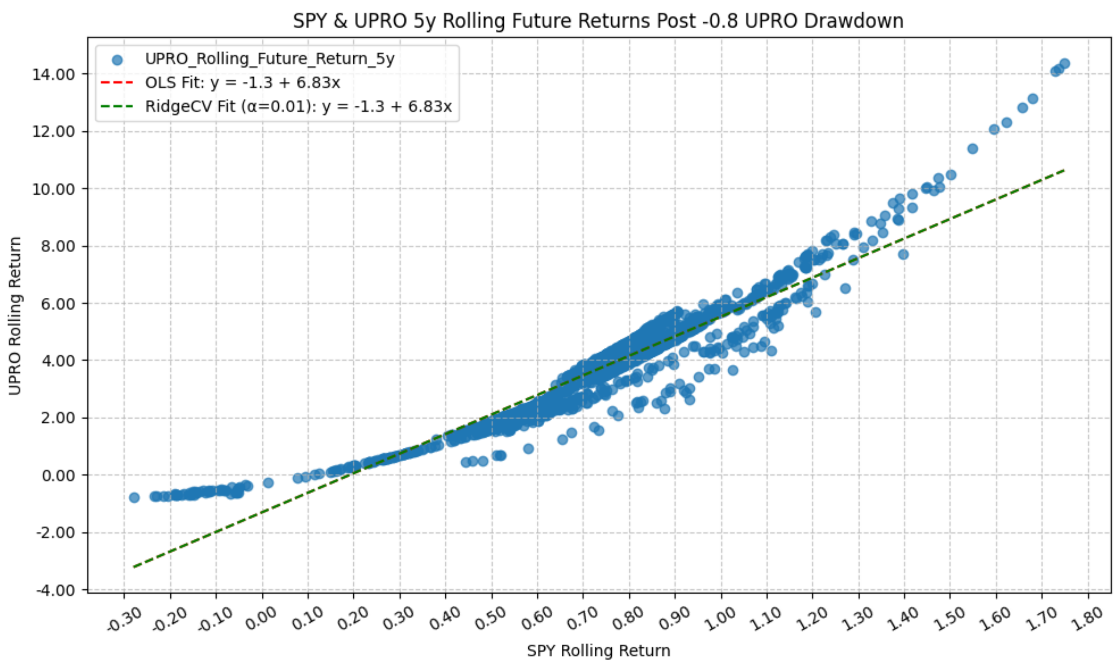





```
                                OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_4y   R-squared:
0.877
Model:                                       OLS   Adj. R-squared:
0.876
Method:                            Least Squares   F-statistic:
1.049e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:38   Log-Likelihood:
-460.04
No. Observations:                           1479   AIC:
924.1
Df Residuals:                               1477   BIC:
934.7
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -1.3231      0.040    -33.268      0.000
```

```
-1.401      -1.245
SPY_Rolling_Future_Return_4y     6.5218      0.064    102.414      0.000
6.397       6.647
==============================================================================
Omnibus:                      317.126   Durbin-Watson:                   0.032
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              747.178
Skew:                          -1.169   Prob(JB):                    5.65e-163
Kurtosis:                       5.580   Cond. No.                         10.2
==============================================================================

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






```
                            OLS Regression Results
================================================================================
=========
Dep. Variable:     UPRO_Rolling_Future_Return_5y   R-squared:
0.895
Model:                                       OLS   Adj. R-squared:
0.895
Method:                            Least Squares   F-statistic:
1.258e+04
Date:                           Mon, 16 Mar 2026   Prob (F-statistic):
0.00
Time:                                   14:29:39   Log-Likelihood:
-1478.3
No. Observations:                           1479   AIC:
2961.
Df Residuals:                               1477   BIC:
2971.
Df Model:                                      1
Covariance Type:                       nonrobust
================================================================================
================
                                   coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
----------------
const                           -1.3147      0.048    -27.526      0.000
```

```
-1.408      -1.221
SPY_Rolling_Future_Return_5y     6.8270      0.061    112.164      0.000
6.708       6.946
==============================================================================
Omnibus:                      180.962   Durbin-Watson:                   0.042
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              814.106
Skew:                           0.496   Prob(JB):                    1.66e-177
Kurtosis:                       6.497   Cond. No.                         5.57
==============================================================================

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

0.5.9 Rolling Returns Following Drawdowns Deviation (SPY & UPRO)

[72]:
```
rolling_returns_positive_future_returns = pd.DataFrame(index=rolling_windows.
 ↪keys(), data=rolling_windows.values())
rolling_returns_positive_future_returns.reset_index(inplace=True)
rolling_returns_positive_future_returns.rename(columns={"index":"Period", 0:
 ↪"Days"}, inplace=True)

for drawdown in drawdown_levels:
    temp = rolling_returns_drawdown_stats.
 ↪loc[rolling_returns_drawdown_stats["Drawdown"] == drawdown]
    temp = temp[["Period", "Positive_Future_Percentage"]]
    temp.rename(columns={"Positive_Future_Percentage" :␣
 ↪f"Positive_Future_Percentage_Post_{drawdown}_Drawdown"}, inplace=True)
    rolling_returns_positive_future_returns = pd.
 ↪merge(rolling_returns_positive_future_returns, temp, left_on="Period",␣
 ↪right_on="Period", how="outer")
    rolling_returns_positive_future_returns.sort_values(by="Days",␣
 ↪ascending=True, inplace=True)

rolling_returns_positive_future_returns.drop(columns={"Days"}, inplace=True)
rolling_returns_positive_future_returns.reset_index(drop=True, inplace=True)
display(rolling_returns_positive_future_returns)
```

```
  Period  Positive_Future_Percentage_Post_-0.1_Drawdown  \
0     1d                                          0.541
1     1w                                          0.572
2     1m                                          0.625
3     3m                                          0.670
4     6m                                          0.704
5     1y                                          0.733
6     2y                                          0.765
7     3y                                          0.721
8     4y                                          0.688
```

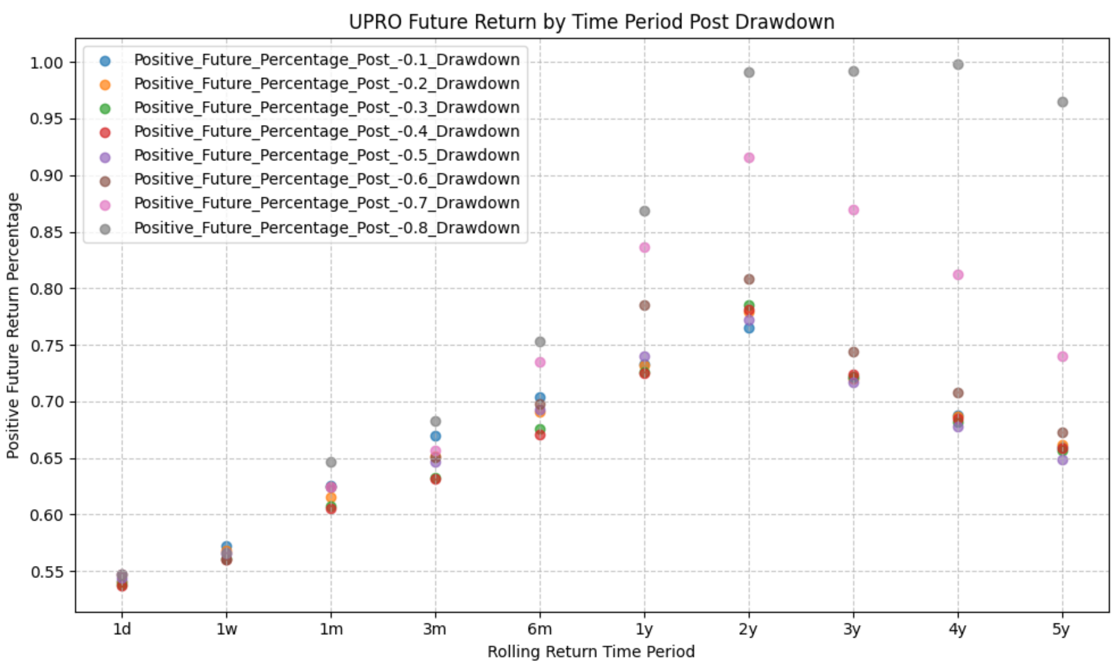
```
9    5y                                        0.659

   Positive_Future_Percentage_Post_-0.2_Drawdown  \
0                                          0.540
1                                          0.568
2                                          0.615
3                                          0.652
4                                          0.691
5                                          0.732
6                                          0.779
7                                          0.720
8                                          0.687
9                                          0.661

   Positive_Future_Percentage_Post_-0.3_Drawdown  \
0                                          0.538
1                                          0.561
2                                          0.607
3                                          0.632
4                                          0.676
5                                          0.726
6                                          0.785
7                                          0.722
8                                          0.682
9                                          0.656

   Positive_Future_Percentage_Post_-0.4_Drawdown  \
0                                          0.537
1                                          0.560
2                                          0.605
3                                          0.632
4                                          0.671
5                                          0.725
6                                          0.782
7                                          0.724
8                                          0.685
9                                          0.658

   Positive_Future_Percentage_Post_-0.5_Drawdown  \
0                                          0.544
1                                          0.565
2                                          0.624
3                                          0.647
4                                          0.692
5                                          0.740
6                                          0.772
7                                          0.717
8                                          0.678
```

```
9                                              0.649

   Positive_Future_Percentage_Post_-0.6_Drawdown  \
0                                              0.547
1                                              0.560
2                                              0.625
3                                              0.650
4                                              0.698
5                                              0.786
6                                              0.809
7                                              0.744
8                                              0.708
9                                              0.672

   Positive_Future_Percentage_Post_-0.7_Drawdown  \
0                                              0.547
1                                              0.566
2                                              0.625
3                                              0.656
4                                              0.735
5                                              0.836
6                                              0.916
7                                              0.870
8                                              0.813
9                                              0.740

   Positive_Future_Percentage_Post_-0.8_Drawdown
0                                              0.547
1                                              0.566
2                                              0.646
3                                              0.683
4                                              0.753
5                                              0.869
6                                              0.991
7                                              0.993
8                                              0.998
9                                              0.966
```

[73]:

```
plot_scatter(
    df=rolling_returns_positive_future_returns,
    x_plot_column="Period",
    y_plot_columns=[col for col in rolling_returns_positive_future_returns.
  ↪columns if col != "Period"],
    title="UPRO Future Return by Time Period Post Drawdown",
    x_label="Rolling Return Time Period",
    x_format="String",
    x_format_decimal_places=0,
```

```
    x_tick_spacing=1,
    x_tick_rotation=0,
    y_label="Positive Future Return Percentage",
    y_format="Decimal",
    y_format_decimal_places=2,
    y_tick_spacing="Auto",
    y_tick_rotation=0,
    plot_OLS_regression_line=False,
    OLS_column=None,
    plot_Ridge_regression_line=False,
    Ridge_column=None,
    plot_RidgeCV_regression_line=False,
    RidgeCV_column=None,
    regression_constant=False,
    grid=True,
    legend=True,
    export_plot=False,
    plot_file_name=None,
)
```



This plot summarizes the future rolling returns well. Similar as to QQQ/TQQQ, for rolling returns up to ~3 months *following* all drawdown levels, we see the rolling returns of UPRO are positive ~65% of the time.

As we extend the time horizon, out to the 2y, 3y, 4y, and 5y mark, the percentage of positive rolling returns following an 80% drawdown increases significantly, and is greater than *95%*. This suggests that while the volatility decay effect is present for UPRO, it may not be as severe as that of TQQQ, which could be due to the less extreme return profile of SPY compared to QQQ.

As an investor, this suggests that the optimal time to buy UPRO would be following a drawdown of 50% or more, and holding for at least 2 years. One could dollar cost average into UPRO following a drawdown of 50% or more, and continue to add to the position with a consistent contribution schedule until all capital has been allocated.