# Volatility Targeting Project Summary

Project brief:
- Build a volatility-targeted portfolio that dynamically scales exposure based on realized volatility.
- Test the approach on SPY, AAPL, TSLA, and NVDA using daily data from 2015 onward.
- Compare each run with a static 100% buy-and-hold benchmark.

Target annualized volatility: 20%
Rolling window: 60 trading days
Exposure cap: 3.0× gross
Benchmark: 100% buy-and-hold in the same asset

## Workflow Followed:

- Choose an asset (AAPL, SPY, NVDA, TSLA...)
- Calculate daily returns
- Compute realized volatility using a rolling window
- Derive exposure: exposure = TargetVol / RealizedVol
- Calculate scaled returns = exposure × asset returns
- Create the cumulative return of the strategy
- Compare against a static 100% exposure benchmark

Static benchmark: exposure fixed at 100% so its cumulative return is (1 + returns).cumprod().

## Volatility Targeting Strategy vs Buy & Hold:

| Ticker | Strategy Final | Benchmark Final | Strategy Total % | Benchmark Total % | Annualized % | Ann. Vol % | Sharpe | Max DD % | Outperformance pp | Works? |
|--------|----------------|-----------------|------------------|-------------------|--------------|------------|--------|----------|-------------------|--------|
| SPY | 5.21 | 3.87 | 421.04 | 286.78 | 16.41 | 21.69 | 0.76 | -31.42 | 134.26 | Yes |
| AAPL | 6.45 | 11.16 | 544.89 | 1016.2 | 18.72 | 21.38 | 0.88 | -30.74 | -471.31 | No |
| TSLA | 5.03 | 27.45 | 403.18 | 2644.98 | 16.04 | 21.11 | 0.76 | -35.61 | -2241.8 | No |
| NVDA | 23.57 | 382.37 | 2257.17 | 38137.13 | 33.77 | 22.36 | 1.51 | -34.67 | -35879.96 | No |

Each ticker is compared to a simple buy & hold benchmark on the same asset. "Works?" indicates whether the volatility targeting strategy delivered more total return than buy & hold over the sample (start: 2015-01-01).

## SPY Strategy Diagnostics

### Cumulative Returns



### Exposure Over Time



### Rolling Annualized Volatility
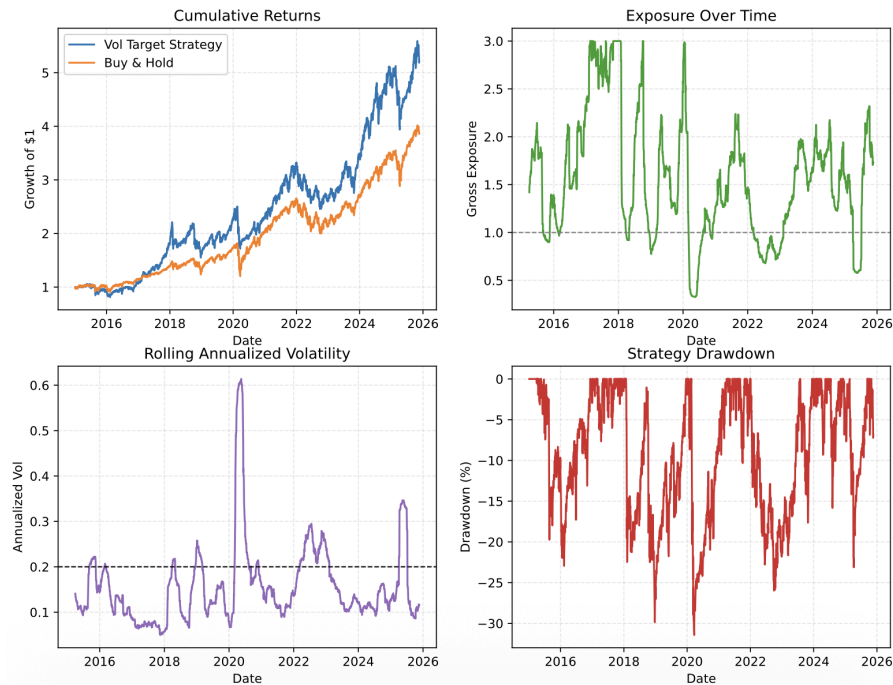


### Strategy Drawdown



# SPY – Strategy vs Benchmark

SPY: The volatility targeting strategy outperformed buy & hold by 134.26 percentage points.
- Strategy total return: 421.04%
- Benchmark total return: 286.78%
- Annualized return / vol / Sharpe: 16.41% / 21.69% / 0.76
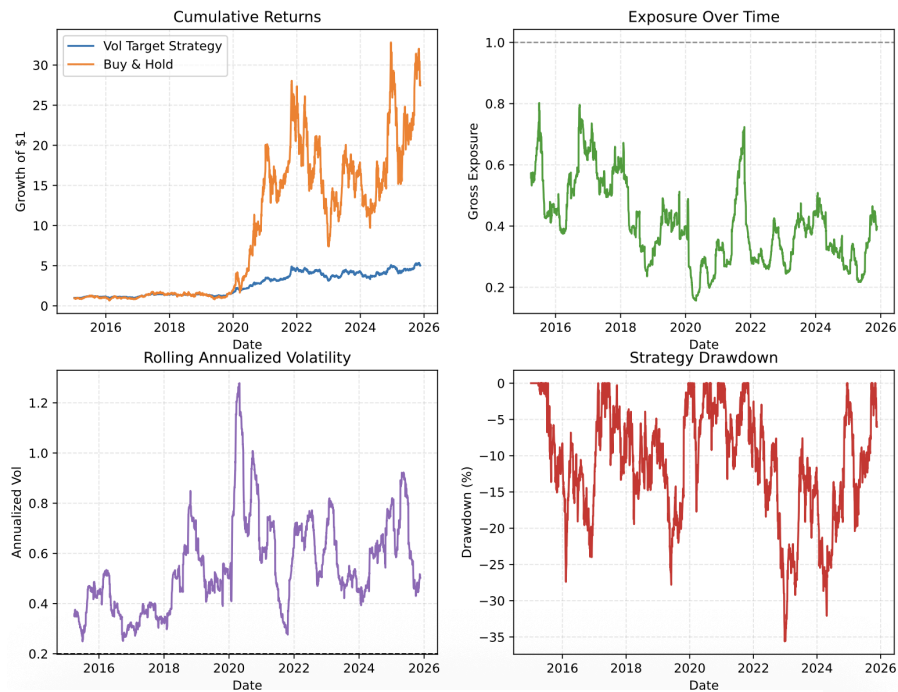- Max drawdown: -31.42%

## AAPL Strategy Diagnostics

### Cumulative Returns



### Exposure Over Time



### Rolling Annualized Volatility
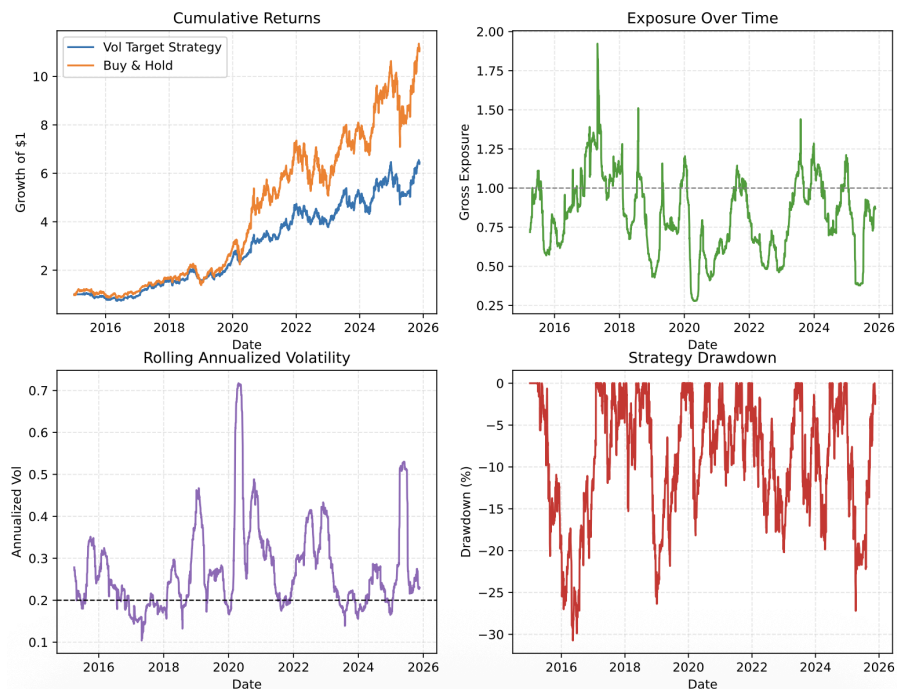


### Strategy Drawdown

# AAPL – Strategy vs Benchmark

AAPL: The volatility targeting strategy underperformed buy & hold by -471.31 percentage points.
- Strategy total return: 544.89%
- Benchmark total return: 1016.20%
- Annualized return / vol / Sharpe: 18.72% / 21.38% / 0.88
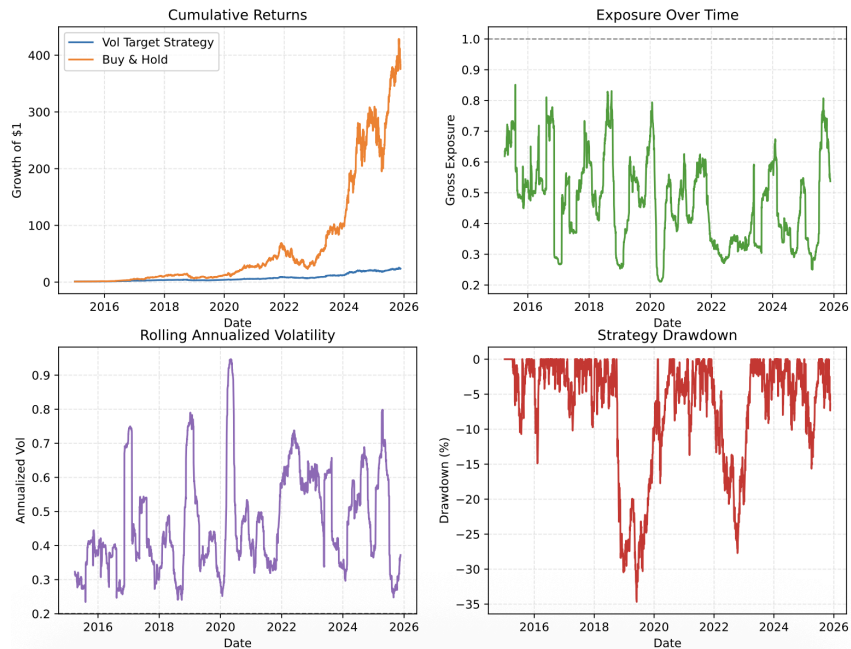- Max drawdown: -30.74%

## TSLA Strategy Diagnostics



# TSLA – Strategy vs Benchmark

TSLA: The volatility targeting strategy underperformed buy & hold by -2241.80 percentage points.
- Strategy total return: 403.18%
- Benchmark total return: 2644.98%
- Annualized return / vol / Sharpe: 16.04% / 21.11% / 0.76
- Max drawdown: -35.61%

## NVDA Strategy Diagnostics

# NVDA – Strategy vs Benchmark

NVDA: The volatility targeting strategy underperformed buy & hold by -35879.96 percentage points.
- Strategy total return: 2257.17%
- Benchmark total return: 38137.13%
- Annualized return / vol / Sharpe: 33.77% / 22.36% / 1.51
- Max drawdown: -34.67%

## In summary:

- I practiced yfinance, pandas, and matplotlib to automate research-quality charts.
- The volatility targeting rule favors calmer assets: it beat the benchmark only on SPY and lagged dramatically on AAPL, TSLA, NVDA.
- Intuition: when realized volatility stays above the target, the strategy throttles exposure, so explosive names like TSLA, AAPL and NVDA cannot express their big moves.

*Key takeaway:* volatility targeting provides smoother equity curves but sacrifices upside when an asset requires embracing high volatility to capture narrative-driven rallies.