

Overview

The script runs on daily EUR/USD bars and demonstrates two research ideas:

1. an **illustrative variance-bound style comparison** between market price P_t and a discounted-sum proxy P_t^* built from a toy “dividend” (carry) series D_t ;
2. a **simple return-predictability exercise** where the dividend-price ratio $dp_t = \log(D_t/P_t)$ is related to future K -day returns via a rolling OLS slope, then mapped to a tiny long/short action for visualization.

Session & platform setup

- `BarPeriod = 1440` creates **daily bars** (1440 minutes).
- `StartDate = 2010` selects the start year from the price history.
- `LookBack = 600` ensures enough history for all rolling windows.
- `asset("EUR/USD")` selects the EUR/USD instrument from the asset list.
- `set(PLOTNOW)` enables live plotting as values are produced.

Series and indexing

- `vars` are rolling arrays aligned with the bar stream via `series(...)`.
- Zorro’s **past indexing**: `x[0]` = current bar, `x[1]` = 1 bar ago, ..., `x[K]` = K bars ago.
- `P = series(priceClose())` holds the close price P_t .
- `R1 = series(log(P[0]/P[1]))` is the **1-day log return** $\ln(P_t/P_{t-1})$ (kept for reference).

Dividend proxy D_t

- `carryDaily = 0.015/252.` sets a constant **daily carry** equal to $\sim 1.5\%$ per annum.
- `D = series(carryDaily)` makes a flat series used as a **toy dividend** D_t .
- A small `eps = 1e-12` constant is used wherever division or `log` could otherwise hit zero.

Part A — Discounted-sum proxy P_t^* and variance comparison

- Purpose: show, in a didactic way, how a **discounted sum** of past “dividends” can be contrasted with the market price.
- Parameters:
 - `Kmax = 126` → **horizon** of ~ 6 months of past dividends.
 - `r_d = 0.0001` → **daily discount rate** $\approx 0.01\%$ ($\sim 2.5\%$ p.a.).
- Construction:
 - `Px = series(0)` stores P_t^* .
 - For each bar (after warm-up), it computes

$$P_t^* \approx \sum_{k=1}^{K_{\max}} \frac{D_{t-k}}{(1+r_d)^k}$$

using the **past** values $D[k]$ and a running discount factor $disc$.

- Rolling variance comparison:
 - Window $w = 500$ bars.
 - Computes **sample variance** of P and P^* over the last w bars:

$$\text{Var}(X) = \frac{1}{W-1} \sum_{i=0}^{W-1} (X_{t-i} - \bar{X})^2$$

- Plots $\text{Var}(P)$ and $\text{Var}(P^*)$, and prints a ratio line every 50 bars.

Part B — Return predictability with dp_t

Signals and targets

- $DP = \text{series}(\log(\max(\text{eps}, D[0])/\max(\text{eps}, P[0])))$ is the **dividend-price ratio**:
 $dp_t = \log(D_t/P_t)$, numerically stabilized with eps .
- $RK = \text{series}(\log(P[0]/P[K]))$ is the **realized** K -day return ($K = 20$, about one trading month), using current price vs. the price K bars ago.

Rolling OLS slope (univariate regression)

- Window $w_{reg} = 500$.
- For $i = 0..w_{reg}-1$, accumulates sums:
 - $\sum X = \sum dp_{t-i}$
 - $\sum Y = \sum r_{t-i}^{(K)}$
 - $\sum X^2, \sum XY$
- Means: $\bar{X} = \frac{1}{w_{reg}} \sum X, \bar{Y} = \frac{1}{w_{reg}} \sum Y$.
- Denominator: $\text{denom} = \sum X^2 - w_{reg} \cdot \bar{X}^2$.
- Slope:**

$$\beta = \begin{cases} \frac{\sum XY - w_{reg} \cdot \bar{X}\bar{Y}}{\text{denom}}, & \text{if denom} \neq 0 \\ 0, & \text{otherwise} \end{cases}$$

- Plotted as "beta(dp->Kret)".

Standardization of dp_t

- Mean and **sample variance** of DP over the same w_{reg} window:
 - $\bar{dp} = \frac{1}{w_{reg}} \sum dp_{t-i}$
 - $s^2 = \frac{1}{w_{reg}-1} \sum (dp_{t-i} - \bar{dp})^2$
- z-score:**

$$z_{dp} = \frac{dp_t - \bar{dp}}{\sqrt{\max(\epsilon, s^2)}}$$

- Clipping: `zClip` is limited to $[-2, +2]$ to bound outliers.

Direction and scaling to an action knob

- **Direction** follows the sign of β :
 - if $\beta > 0$: `sig = zClip` (same sign as z_{dp});
 - if $\beta < 0$: `sig = -zClip` (inverted).
- `Target = sig` is in $[-2, +2]$.
- `Lev = Target/2.0` rescales to $[-1, +1]$ and is **capped** at `MaxLev = 0.5`.
- This `Lev` is a **display/logic knob** in the demo, not Zorro's built-in `Leverage` variable (the name is intentionally different).

Minimal trade mapping

- If `Lev > 0.05` : flat shorts are closed and a **long** is opened (`Lots = 1`).
- If `Lev < -0.05` : flat longs are closed and a **short** is opened (`Lots = 1`).
- Otherwise: both sides are **exited** (flat).
- This yields visible position changes proportional to the dp-based signal, suitable for plots.

Plot outputs

- **Part A**: `"Var(P)"` , `"Var(P*)"` show rolling variances for price and discounted proxy.
- **Part B**: `"beta(dp->Kret)"` shows the OLS slope; `"z(dp)"` shows the standardized dp; `"lev"` shows the bounded action knob `Lev`.

Guardrails used in calculations

- `eps = 1e-12` avoids division by zero and `log(0)` in dp_t and derived stats.
- Window and lookback checks ensure the script waits until enough history is available before computing P_t^* , variances, z-scores, or regression slopes.

Execution flow in `run()`

1. Initialize series on the first bars (per `LookBack`).
2. **Part A** builds P_t^* from past `D` , then (after enough bars) computes and plots rolling variances.
3. **Part B** (after enough bars) computes dp_t , standardizes it, estimates a rolling β , maps the result to `Lev` , performs a minimal long/short action, and plots diagnostics.
4. Zorro advances bar-by-bar; plotting and console prints update accordingly.