Project Proposal
Stacking Time-Series Momentum and Carry with Risk Budgeting

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1 Trading Question

Can a combined Time-Series Momentum (TSMOM) and Carry signal, applied across liquid global futures, deliver robust, crisis-resilient returns in recent regimes (post-2015 through COVID and the 2022 inflation shock) once we control for roll mechanics, transaction costs, and modern risk budgeting?

Intuition: Both signals are simple, transparent, and documented across *equity index, rates, FX, and commodity* futures. Their economics differ: TSMOM aims to harvest medium-horizon trends, while Carry monetizes term-structure premia. Their low correlation suggests that a practical combination can improve Sharpe and minimize drawdown relative to either leg alone and provide strategy diversification benifits.

Anchor papers: The plan is grounded in two famous, cross-asset concepts:
Time-Series Momentum (TSMOM) (Moskowitz, Ooi, and Pedersen 2012) and
Carry (Koijen et al. 2018).
Additional References: (Asness, Moskowitz, and Pedersen 2013), and (Gorton and Rouwenhorst 2006).

2 Plan of Analysis

2.1 Success Metrics

Portfolio-level performance:

- **Annualized Sharpe** $S = \dfrac{\mathbb{E}[r]}{\sigma(r)}\sqrt{A}$, **Sortino** (downside volatility), **Max drawdown**, **Calmar**, **tail** shape (skew, excess kurtosis).
- **Diversification**: correlations vs. MSCI ACWI (equities) and Agg (bonds), and regime-conditional correlations (pre/post-2015, COVID, 2022-2023 inflation regime).
- **Crisis-*hit rate***: fraction of equity bear months in which the strategy is positive.

Signal quality:

- **Information ratio** (TSMOM-only, Carry-only, and the combined stack).
- **Turnover** and **implementation shortfall**

- **Stability**: parameter drift and realized vs. forecast risk error.

Statistical testing:

- **Walk-forward** cross-validation with expanding windows, report dispersion across folds (*time-series CV*.
- **Diebold-Mariano** tests for forecast loss differences

2.2 Data

Universe: Major exchange-traded futures across four sleeves:
Equities (ES, NQ, EURO STOXX 50, TOPIX),
Rates (UST, Bund, Gilt, JGB),
FX (G10 currency futures),
Commodities (energy, metals, ags).
This mirrors the universes in the papers and typical industry implementations

Horizon: 1990-present where available, with an out-of-sample holdout for 2019-present.

Fields: Daily: open/high/low/close/settlement, volume, open interest, contract specs (eg. tick), *front/back* prices for roll and carry.

Data Sources: Bloomberg, Refinitiv, Nasdaq Data Link, CSI, Databento

2.3 Data Preparation and Engineering

1. **Continuous contracts and roll rules.** Implement two roll rules per asset: *(i) Open-Interest Switch*, *(ii) Time-Based*. Create both *back-adjusted* and *ratio-adjusted* series. Carry calculations use *actual front/back* quotes.
2. **Return alignment:** Signals formed at date t trade at $t+1$. Align global holidays and time zones (UTC)
3. **Volatility estimation:** Rolling realized volatility (EWMA/ GARCH) for position scaling. Set up bounds to avoid leverage blowups.
4. **Costs:** account for market frictions, transaction costs and slippage

2.4 Models

Signals

Time-Series Momentum (TSMOM): For contract i, compute past k-month return $r_{i,t}^{(k)}$. Position is $\text{sign}(r_{i,t}^{(k)})$ (long if positive, short if negative), scaled by target volatility. Evaluate $k \in \{3, 6, 12\}$.

Carry: Define *carry* from the futures curve. Go long high-carry and short low-carry within each sleeve, scaling to a sleeve-level risk target. Use sleeve-neutral construction to avoid concentration.

Stacking & risk budgeting:

- **Volatility targeting**: per-asset positions scaled to a common ex-ante risk, then aggregated to a portfolio target.
- **Stacking TSMOM and Carry**: an *equal-weight* and a *risk-parity* blend are baselines. The primary model uses a *constrained ridge* on a rolling window to choose the blend between TSMOM and Carry, minimizing ex-post variance subject to turnover caps.
- **Constraints and hygiene**: gross exposure cap, per-asset and per-sleeve risk caps.

2.5 Validation

Cross-validation: Use expanding-window, time-series CV.

Benchmarks: (i) TSMOM-only, (ii) Carry-only, (iii) 50/50 blend, (iv) sleeve-level risk parity, and (v) the stacked model.

Stress tests: Update frictions, switch vol estimators (EWMA, GARCH) to ensure conclusions are not estimator-specific.

Appendix A: Metric Definitions

Metric	Definition (daily returns r_t; annualization factor A)
Sharpe	$\frac{\overline{r}}{\sigma(r)}\sqrt{A}$
Sortino	$\frac{\overline{r}}{\sigma(r\mathbf{1}\{r<0\})}\sqrt{A}$
Max Drawdown	$\max_{t\le s}\frac{\text{Peak}_t-\text{NAV}_s}{\text{Peak}_t}$
Calmar	Annualized Return/Max Drawdown
Crisis Hit-Rate	$\#\{\text{equity-bear months with } r>0\}/\#\{\text{equity-bear months}\}$
Turnover	$\sum_i \lvert w_{i,t}-w_{i,t-1}\rvert/2$ per rebalance
Impl. Shortfall	(Model P&L) − (Paper P&L with costs), attributed to slippage

Appendix B: Formal Signal Sketches

TSMOM. $s_{i,t}^{\text{mom}} = \text{sign}\big(\prod_{j=1}^{k}(1+r_{i,t-j})-1\big)$. Position $w_{i,t}^{\text{mom}} \propto s_{i,t}^{\text{mom}}/\widehat{\sigma}_{i,t}$.

Carry. For front F_1 and next F_2 with maturities $\tau_1<\tau_2$, define annualized roll-yield $\text{Carry}_{i,t} \approx \frac{F_{2,t}/F_{1,t}-1}{\tau_2-\tau_1}$. Rank within sleeve. Long high-carry, short low-carry, then scale by sleeve risk target.

Stacking. Portfolio weights $w_t = \alpha_t w_t^{\text{mom}} + (1-\alpha_t) w_t^{\text{carry}}$ with α_t fit on a rolling window by ridge to minimize realized variance subject to turnover and weight caps. Rescale to hit the vol target.

References

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AI usage: ChatGPT was used for copy-editing of the Analysis Plan