Strategy Spotlight: Barbell Horizons CTA Replication

June 2025, Ai For Alpha Team

Abstract

Managed-futures programmes play an essential role in institutional portfolios, combining attractive long-run returns with robust protection in protracted drawdowns. Yet investors increasingly seek transparent, cost-efficient ways to access "crisis alpha" without paying legacy 2% + 20% fees or accepting opaque black-box models.

Barbell Horizons CTA Replication is Ai For Alpha's systematic answer to that demand. We replicate diversified CTA trend followers using three investable building blocks applied consistently across a liquid global futures universe: (i) a short-term trend sleeve built from 10–60 day look-back straddles (STT); (ii) a long-term trend sleeve based on a 500-day look-back straddle (LTT); and (iii) an equally weighted raw market sleeve capturing directional futures returns (MKT). A Bayesian graphical model allocates dynamically across these components, tilting toward fast trend in choppy, shock-driven regimes and toward slow trend and market beta when persistent macro trends reassert themselves.

The flagship implementation of this framework—the Barbell Horizons replication strategy, implemented as a 50/50 blend of MKT and STT—tracks the SG CTA Trend Index with around 80% correlation while approximately doubling its efficiency ratio (return relative to maximum drawdown) over the last decade. The same engine can be configured to emphasise long-term crisis hedging, multi-horizon replication, or pure short-term convexity overlays.

This note sets out the economic rationale, modelling approach and headline performance of Barbell Horizons CTA Replication, and explains how allocators can embed it as a liquid, scalable risk-transfer overlay in multi-asset portfolios.

1 Background and Motivation

CTA trend-following strategies have delivered decades of diversifying returns, with particularly strong pay-offs during sustained dislocations in rates, FX and commodities. In 2022, for example, large diversified CTAs gained roughly 25% as global rates sold off, the US dollar surged and commodities repriced sharply in one direction. That tailwind largely faded in 2023, leaving investors with two questions:

- How can we retain the structural crisis-hedging benefits of CTAs when slow, directional trends are scarce?
- Can we access CTA-like pay-offs in a transparent, capital-efficient and fee-efficient format?

Traditional replication approaches fall into two buckets:

(a) **Bottom-up market replication**, using direct futures positions that attempt to mimic large CTAs' positions; and

(b) **Factor replication**, using generic "trend" factors with medium-term horizons (typically 3–12 months) built on price or moving-average filters.

Both are useful, but both typically over-emphasise the same crowded medium-term horizon, and often neglect the incremental convexity available from very short-term trend signals.

Our research supports a different design principle:

> *Concentrate trend risk at the extremes of the horizon spectrum—fast breakout signals and very slow structural trend—and augment it with a transparent market-return sleeve.*

The **Barbell Horizons CTA Replication** framework embodies this idea. Its core features are:

- **Short-term edge.** Fast breakout signals monetise policy surprises and sharp reversals that slow systems miss, adding convexity and shortening "time-to-help" in crises.
- **Slow-trend backbone.** A 500-day trend sleeve captures long structural moves in rates, FX and commodities, anchoring drawdown protection.
- **Market-overlay augmentation.** An equally weighted market sleeve harvests long-run futures risk premia and stabilises performance when directional trends temporarily fade.
- **Dynamic Bayesian allocation.** A state-space model learns, in real time, how much weight to place on each building block by observing the behaviour of the SG CTA Trend Index.

The result is a liquid, transparent and scalable replication of diversified CTA trend followers that offers improved risk-adjusted pay-offs for a given level of benchmark tracking.

2 Strategy Architecture

2.1 Futures Universe and Cost Model

Barbell Horizons is implemented on a diversified, highly liquid futures universe representing the standard exposures of large CTA programmes across equities, rates, FX and commodities. The universe contains about two dozen contracts across major exchanges in North America, Europe and Asia. Implementation costs—both trading and roll—are applied consistently across all sleeves.

- **Transaction cost (Tx).** Round-turn execution cost (bid–ask, brokerage, exchange and clearing fees plus slippage), in basis points of notional notional traded. Orders from different sleeves are *netted across the library* at the instrument level before execution.
- **Replication (roll) cost.** Systematic carry/roll drag incurred when the front contract is rolled to the next maturity, calibrated from long-run average front-to-next calendar spreads.
- **Management fee.** A flat 50 bps per annum on AUM is reserved for management fees when reporting net performance.

Asset class	**Costs (Tx, Roll)**	**Instruments (exchange)**
Commodities	2 / 15 bps	GC (COMEX); CL, NG (NYMEX); CO (ICE Europe); HG (COMEX)
Equity Indices	2 / 15 bps	ES, NQ (CME); NK (OSE); FESX (Eurex); Z (ICE Europe); E-mini EM (CME)
Fixed Income (Rates)	2 / 10 bps	TU, TY (CBOT); RX (Eurex); G (ICE UK Gilts); JGB (OSE); XM (ASX)
FX (vs USD)	2 / 2 bps	EUR, JPY, GBP, AUD, CAD (CME)

Table 1: Futures universe and cost assumptions (Tx = round-turn transaction cost; Roll = average front-to-next spread). Costs are expressed in basis points of notional and applied consistently across all sleeves.

All sleeves are volatility-targeted to a common annualised volatility. Costs are applied to *filled* notional after sleeve netting. Rolls follow exchange calendars and incur costs only when contracts are actually rolled. Because orders are netted per instrument across sleeves before routing, reported turnover and costs reflect the implementation of the *whole* Barbell Horizons engine rather than any single component in isolation.

2.2 Look-Back Straddles as Trend Filters

Trend signals in Barbell Horizons are built from *look-back straddles*, which are options whose payoff depends on the path of the underlying over a window, not just its terminal price. Owning both a look-back call and put over a window h days creates a payoff that increases with the largest up *or* down excursion over that window.

The key intuition is that the daily *delta* of such a look-back straddle is:

- positive near recent highs,
- negative near recent lows,
- close to zero when price oscillates inside a range.

This is exactly how a breakout trend-following rule behaves: scale long positions near highs, short positions near lows, and stay small in congested markets.

For market i with price $P_{t,i}$ and excess return $m_{t,i}$, define running extremes on window h:

$$H_{t,i}^{(h)} = \max_{1\le \ell \le h} P_{t-\ell,i}, \qquad L_{t,i}^{(h)} = \min_{1\le \ell \le h} P_{t-\ell,i},$$

together with a robust volatility scale $S_{t,i}^{(h)}$. A simple look-back-style trend score is

$$s_{t,i}^{(h)} \;=\; \frac{P_{t-1,i} - \frac{1}{2}(H_{t-1,i}^{(h)} + L_{t-1,i}^{(h)})}{S_{t-1,i}^{(h)}},$$

mapped to a bounded position $\pi_{t,i}^{(h)} \in [-1, 1]$ (for instance via a hyperbolic tangent), with per-market factor return

$$g_{t,i}^{(h)} \;=\; \pi_{t-1,i}^{(h)}\, m_{t,i},$$

rescaled to a common volatility target per horizon.

Table 2: Look-back straddle mechanics and CTA analogues

Concept	**Intuition**	**CTA Analogue**
Path-dependent payoff	Rewards *max/min* excursions over h.	Trend P&L depends on the path, not just the close.
Straddle symmetry	Long call+put captures both tails.	Long in up-trends, short in down-trends.
Delta as trend score	$+$ near highs, $-$ near lows, ≈ 0 in ranges.	Breakout sizing by distance to extremes.
Window h	Sets reaction speed and holding horizon.	Fast vs. slow trend horizons.
Convexity	Positive skew from large moves.	CTAs' crisis convexity ("crisis alpha").

2.3 Short- and Long-Term Trend Sleeves

Barbell Horizons uses two main trend sleeves:

- **STT (Short-Term Trend).** Average of four fast look-back straddles with windows 10, 20, 40 and 60 days, each built from the construction above and combined into a single volatility-targeted sleeve.
- **LTT (Long-Term Trend).** A very slow trend sleeve based on a 500-day look-back straddle, capturing long-horizon macro trends in rates, FX and commodities.

For horizon h and market i, we aggregate per-market returns into a portfolio sleeve

$$F_t^{(h)} \;=\; \sum_{i=1}^{N} w_{i,t}^{(h)}\, g_{t,i}^{(h)},$$

where $w_{i,t}^{(h)}$ are simple risk-parity weights rescaled so each sleeve targets the same annualised volatility. The short-term sleeve STT is then

$$\mathrm{STT}_t \;=\; \frac{1}{4} \sum_{h \in \{10,20,40,60\}} F_t^{(h)},$$

while the long-term sleeve is simply

$$\mathrm{LTT}_t \;=\; F_t^{(500)}.$$

2.4 Strategy Sleeves and Notation

On top of STT and LTT we use a transparent raw-market sleeve:

- **MKT (Markets).** An equally weighted portfolio of raw daily futures excess returns, volatility-targeted to the same level as STT and LTT.

From these three building blocks we form the following sleeves:

- **STT** – short-term trend sleeve.

- **LTT** – long-term trend sleeve.
- **MKT** – raw market returns (pure beta).
- **STT+LTT** – a 50/50 blend of STT and LTT (pure trend barbell).
- **BHR (Barbell Horizons CTA Replication).** Implemented as a 50/50 blend of MKT and STT (MKT+STT), this is the flagship replication sleeve used throughout this note.
- **MKT+STT+LTT** – equal thirds of MKT, STT and LTT (multi-horizon trend plus beta).
- **SG CTA Trend Index** (ticker NEIXCTAT) – benchmark of the ten largest diversified CTAs, equally weighted, live since January 2000.

The Barbell Horizons engine maintains all these components internally. A Bayesian model (Section 3) learns how the SG CTA Trend Index loads on STT, LTT and MKT, and uses this information to calibrate the BHR sleeve as a liquid, investable proxy for diversified CTA exposures.

3 Bayesian Allocation Engine

3.1 State-Space Set-Up

We model daily returns of the SG CTA Trend Index as a time-varying mixture of three latent factors: short-term trend (STT), long-term trend (LTT) and raw market return (MKT). Formally, in excess-return space:

$$r_t^{\mathrm{SG}} \;=\; \beta_t^{\mathrm{STT}}\,\mathrm{STT}_t + \beta_t^{\mathrm{LTT}}\,\mathrm{LTT}_t + \beta_t^{\mathrm{MKT}}\,\mathrm{MKT}_t + \varepsilon_t,$$

with a latent state vector $\boldsymbol{\beta}_t = (\beta_t^{\mathrm{STT}}, \beta_t^{\mathrm{LTT}}, \beta_t^{\mathrm{MKT}})^\top$ following a Gaussian random walk:

$$\boldsymbol{\beta}_t = \boldsymbol{\beta}_{t-1} + \boldsymbol{\eta}_t, \quad \boldsymbol{\eta}_t \sim \mathcal{N}(0, Q).$$

Intuitively, the model says that the SG CTA Trend Index behaves like a dynamically rebalanced portfolio of STT, LTT and MKT, with slowly evolving weights.

3.2 Graphical Representation

The system can be visualised as a simple two-layer Bayesian network: hidden factor weights generate observed index returns, while the weights themselves evolve smoothly through time and can interact across asset clusters.

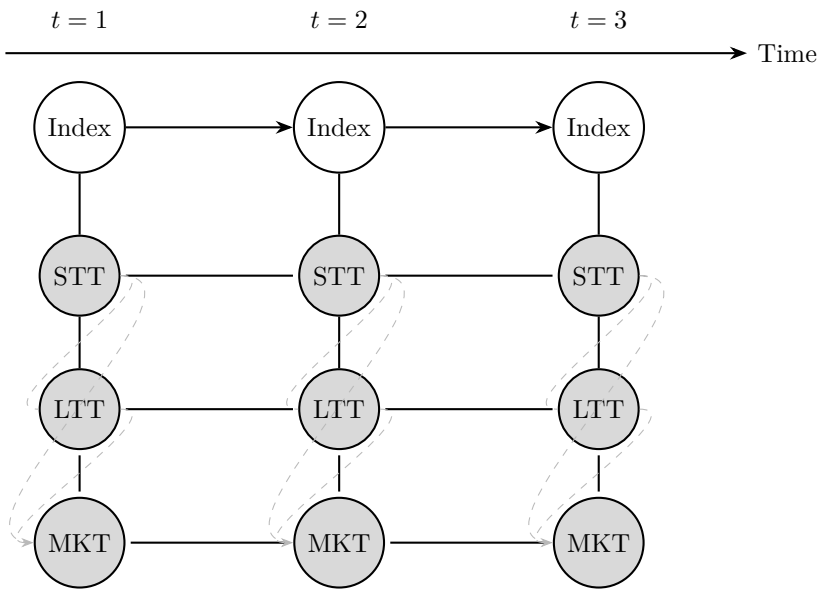

Figure 1: Bayesian network for CTA replication. Hidden weights on three sleeves (STT, LTT, MKT) evolve through time and generate observed SG CTA Trend index returns. Dashed links mark same-date interactions retained by a sparsity-inducing prior.

We use a sparse multivariate prior (for example, Horseshoe-style) on the interaction structure so that the filter keeps only the links that materially improve fit. A forward-filter / backward-smoothing algorithm then yields the full posterior path of factor weights $\boldsymbol{\beta}_t$.

3.3 Practical Pay-Off

The Bayesian engine serves two roles:

- **Style decoder.** It provides a daily "horizon fingerprint" of the SG CTA Trend Index, summarising how much of its risk is currently carried by fast trend, slow trend and raw beta.
- **Allocator.** It translates that fingerprint into live weights for Barbell Horizons CTA Replication, keeping the BHR sleeve aligned with the way leading CTAs actually deploy trend risk through time.

In practice, the model tends to tilt:

- toward STT when markets are choppy and driven by policy shocks or rapid reversals;
- toward LTT during persistent macro trends (for example, multi-year rate cycles); and
- toward MKT in "grind" regimes where trend signals temporarily weaken but risk premia remain positive.

4 Performance Evidence

4.1 Headline Results (2015–2025)

Table 3 summarises the risk–return statistics of the main sleeves from January 2015 to June 2025, net of estimated transaction, roll and management costs. The flagship Barbell Horizons sleeve (BHR = MKT+STT) delivers the best trade-off between risk-adjusted return and drawdown while maintaining strong tracking to the SG CTA Trend Index.

Table 3: Risk–return snapshot (2015–2025)

	BHR (MKT+STT)	STT	LTT	STT+LTT	SG CTA Trend
Sharpe	**0.49**	0.20	0.39	0.40	0.03
Max DD (%)	**-14.9**	-15.2	-18.8	-16.7	-22.4
Return/Max DD	**0.48**	0.26	0.32	0.35	0.11
Corr. to SG CTA Trend	0.80	0.65	0.81	**0.84**	1.00

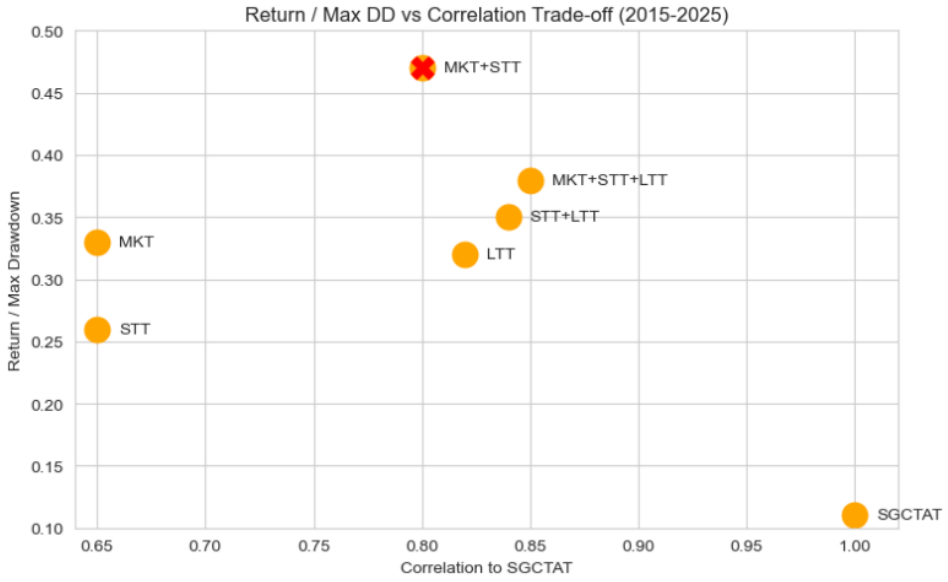

Figure 2: Return/Max DD versus benchmark correlation. The Barbell Horizons sleeve (BHR = MKT+STT, highlighted in the original analysis) swaps a few correlation points for a sizeable uplift in risk-adjusted payoff.

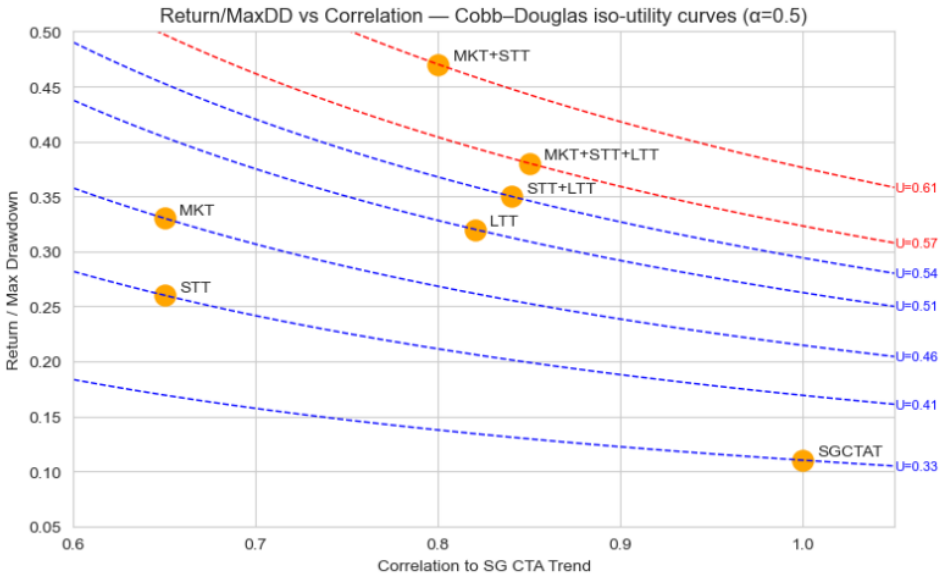

Figure 3: Cobb–Douglas iso-utility curve with $\alpha = 0.5$ (equal weight on correlation and Return/MaxDD). The ridge peaks at Barbell Horizons (BHR); all competing sleeves lie strictly below the curve.

Interpretation. Table 3 shows the raw numbers and Figure 2 visualises the trade-off: Barbell Horizons surrenders only 3–4 correlation points relative to the best pure-trend tracker yet delivers the highest return for every percent of drawdown. Figure 3 tells the same story through a correlation/efficiency utility curve: BHR lies on the utility ridge, while alternative trend sleeves sit inside the iso-utility contour.

4.2 Robustness Across Regimes

We now stress-test the Barbell Horizons sleeve across two distinct environments: (i) the recent COVID–inflation regime, and (ii) a full 20-year backtest that spans multiple business and policy cycles.

4.2.1 Live COVID–Inflation Window (Jun 2020 – Jun 2025)

Table 4: Five-year live window (Jun 2020 – Jun 2025)

	BHR (MKT+STT)	MKT	LTT	STT	STT+LTT
Sharpe/Max DD	3.05	3.91	2.44	1.55	2.17
Return/Max DD	0.53	0.66	0.42	0.35	0.40
Max DD (%)	-14.9	-14.8	-18.8	-15.2	-16.7
Sharpe	0.45	0.58	0.46	0.24	0.36

Read-through. Even amid unprecedented policy swings, supply-chain disruptions and inflation scares, Barbell Horizons kept drawdowns below 15%. The BHR sleeve thus behaved as a liquid overlay: it remained engaged in risk markets while preserving capital through turbulent episodes, validating its role as a resilient diversifier rather than a fragile crisis "lottery ticket".

4.2.2 Full Back-Test (Dec 2004 – Jun 2025)

Table 5: Twenty-year history (Dec 2004 – Jun 2025)

	BHR (MKT+STT)	MKT	LTT	STT	STT+LTT
Sharpe/Max DD	4.94	3.08	4.01	2.67	4.65
Return/Max DD	0.64	0.45	0.53	0.38	0.58
Max DD (%)	-14.9	-20.3	-18.8	-15.2	-16.7
Sharpe	0.74	0.62	0.75	0.41	0.77

Read-through. Across the global financial crisis, the euro-area sovereign crisis, QE and QT cycles and the COVID/inflation shock, Barbell Horizons consistently reduced drawdowns relative to pure market exposure and delivered higher returns per unit of downside risk. The edge appears structural—rooted in the fast trend plus market-return barbell—rather than dependent on any single macro regime.

5 Implementation Blueprint and Use Cases

5.1 Operational Implementation

- **Universe.** Around 24 highly liquid futures across equities, rates, FX and commodities, as summarised in Table 1.
- **Signal Engine.** Daily look-back straddles; equally weighted short-term horizons (10–60 days) for STT and a 500-day horizon for LTT, all volatility-targeted.

- **Allocator.** Proprietary Bayesian graphical model allocating across MKT, STT and LTT, calibrated on the SG CTA Trend Index.
- **Transaction Costs.** Fully integrated into the strategy, including execution and roll costs. Estimated total cost ranges from 1.30% to 1.70% annually (including a 50 bp management-fee provision), depending on volatility target and market liquidity conditions.
- **Risk and Performance Monitoring.** Real-time tracking of portfolio risk, performance attribution by sleeve (MKT, STT, LTT) and horizon, and continuous drawdown and stress analytics.

5.2 Institutional Use Cases

For institutional allocators, Barbell Horizons CTA Replication can be slotted into portfolios in several ways:

1. **Sharpe enhancement for balanced portfolios.** As a standalone sleeve, BHR offers attractive risk-adjusted returns with low to moderate correlation to traditional 60/40 portfolios, improving overall portfolio efficiency.
2. **Capital-efficient crash overlay.** Implemented via futures or swaps, Barbell Horizons can sit on top of existing equity and credit exposures as a "liquid insurance" layer, reducing left-tail risk without fully sacrificing carry.
3. **Fee-efficient CTA core holding.** For investors already allocating to traditional CTAs, BHR provides a transparent, low-fee core exposure around which to rotate or opportunistically tilt allocations to individual managers.
4. **Strategic diversifier in LDI and endowment portfolios.** The combination of fast trend, slow trend and market beta offers a robust diversifier to duration and inflation risk, particularly valuable for LDI, insurance and endowment investors managing long-dated liabilities.

6 Allocation Takeaways

The empirical results above suggest several clear messages for allocators considering Barbell Horizons CTA Replication:

- **Sharpen the Sharpe, not just the correlation.** For inclusion in multi-asset portfolios, the quality of returns—Sharpe ratio and Return/MaxDD—matters at least as much as correlation to the SG CTA Trend Index. Barbell Horizons is explicitly engineered to sit on the efficient frontier of this trade-off.
- **Own convex carry.** Short-term trend signals provide cost-efficient long-gamma exposure, monetising abrupt moves without the constant bleed associated with long option positions. Coupled with market beta, they create a convex "carry-with-protection" profile.
- **Defend the downside.** Sub-15% strategy-level drawdowns preserve institutional risk budgets and make it easier to rebalance into dislocated assets when opportunities arise.
- **Keep it transparent and scalable.** The entire framework is implemented using publicly observable futures data. There are no proprietary price feeds, exotic instruments or capacity bottlenecks, and the Bayesian engine provides an interpretable mapping from factor weights to realised behaviour.

7 Conclusion

Barbell Horizons CTA Replication offers a pragmatic, institutionally robust path to accessing CTA-like crisis :

- It is built from three transparent, investable building blocks—short-term trend and raw market beta—applied consistently across a liquid global futures universe.
- A Bayesian graphical model decodes the evolving style of the SG CTA Trend Index and translates it into dynamic allocations across these sleeves.
- The flagship implementation, BHR (a 50/50 blend of MKT and STT), tracks the SG CTA Trend Index with around 80% correlation while significantly improving the return-to-drawdown profile over the last decade and across multiple macro regimes.
- The approach is cost-efficient, capacity-friendly and operationally straightforward, making it suitable both as a standalone diversifier and as a core component of broader CTA allocations.

By concentrating trend risk at the extremes of the horizon spectrum and augmenting it with transparent market exposure, Barbell Horizons CTA Replication delivers resilient, convex pay-offs that integrate naturally into modern institutional portfolios.

Disclaimer

This document is for research discussion only. Backtested results are hypothetical and subject to model risk; they do not reflect trading costs, capacity limits, or operational frictions beyond those stated. Past performance is not indicative of future results.