Copper/Oil Ratio Macro Regime Overlay for Equity Indices (Public Summary)

Abstract
This paper presents a rule-based **macro regime overlay** driven by the **Copper/Oil ratio** to manage long-only equity index exposure. The method does not target short-horizon return prediction; instead, it classifies market conditions into **Risk-On (ON)** vs **Risk-Off (OFF)** regimes and uses the regime state to **gate or scale** equity exposure. Across multiple major indices, the overlay exhibits strong **regime state separation**—ON regimes have materially better risk-adjusted outcomes than OFF regimes. The dominant contribution comes from **tail-risk mitigation**, evidenced by meaningfully reduced losses during worst-market-day quantiles. Failures are concentrated in **event-driven/policy shock** episodes, where discontinuous repricing can occur faster than a macro proxy can adapt. This is a public summary; exact implementation parameterization is intentionally omitted.

1. Motivation

Macro proxies can be useful not as short-term predictors, but as **slow-moving risk context** for exposure management. The **Copper/Oil ratio** is a compact representation of the balance between:

- **industrial demand / growth impulse** (copper), and
- **energy cost / inflation pressure** (oil).

The central hypothesis is that changes in this balance can coincide with persistent **risk appetite** shifts. Rather than forecasting next-day returns, the Copper/Oil ratio is used as a **macro-frequency overlay** to:

- remain invested during favorable conditions (**ON**), and
- reduce exposure during unfavorable conditions (**OFF**).

2. Strategy Overview (High Level)

2.1 Overlay objective

The overlay is designed as a **top-level risk switch** applied to a baseline long-only equity index exposure:

- **ON (Risk-On):** allow long exposure
- **OFF (Risk-Off):** reduce/neutralize exposure

2.2 Stability and turnover control

To avoid excessive switching caused by boundary noise, the regime classifier is constructed to be robust via:

- signal standardization, and
- a two-threshold switching rule (hysteresis-style behavior) to reduce regime churn.

2.3 Realistic timing convention

The regime state is applied with a realistic convention (signal at *t* affects exposure from *t+1* onward) to avoid look-ahead effects.

3. Data, Markets, and Evaluation Design

3.1 Markets covered

This research evaluates the overlay across several major equity indices. For clarity, the presentation is split into:

Primary figures shown in the report (one per region)

- **Hong Kong:** `^HSI`
- **China (A-share proxy):** `SS001`
- **Japan:** `^N225`

Additional validation indices (tested, referenced for robustness)

- **Hong Kong:** `^HSCE`
- **China:** `CSI300`

3.2 Backtest framing (public)

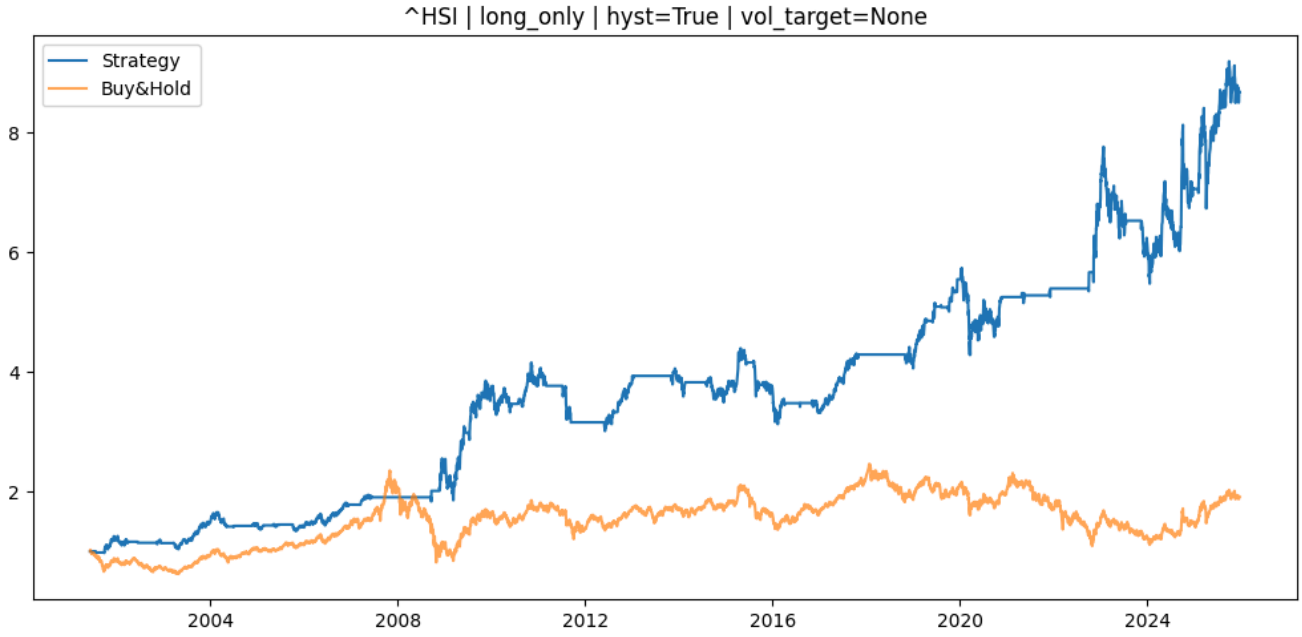
- Frequency: daily data
- Overlay exposure: long-only when ON; reduced/neutral when OFF
- Core outputs:
  - annualized return/volatility, Sharpe, max drawdown
  - regime share (time in ON) and flip frequency
  - tail-loss behavior (worst-day quantile loss reduction)

4. Backtest Evidence

The figures below provide the primary empirical evidence.

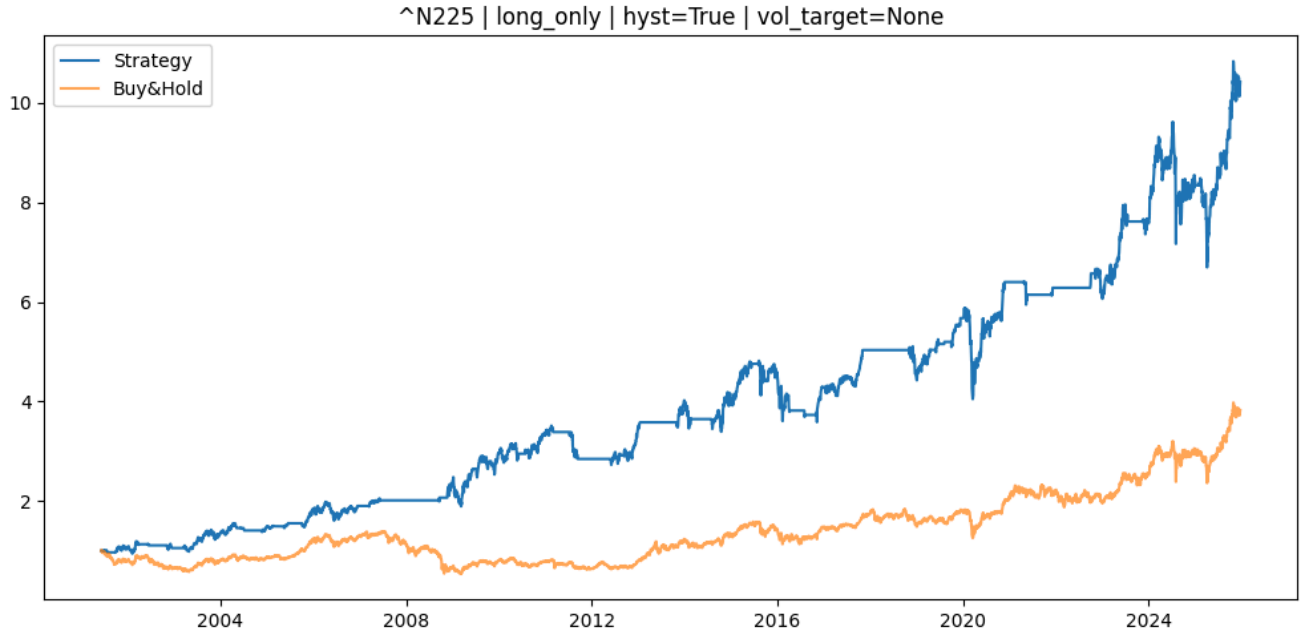
4.1 Equity curve: Overlay vs Buy & Hold

- **Figure 1:** `^HSI` equity curve (Overlay vs Buy & Hold)



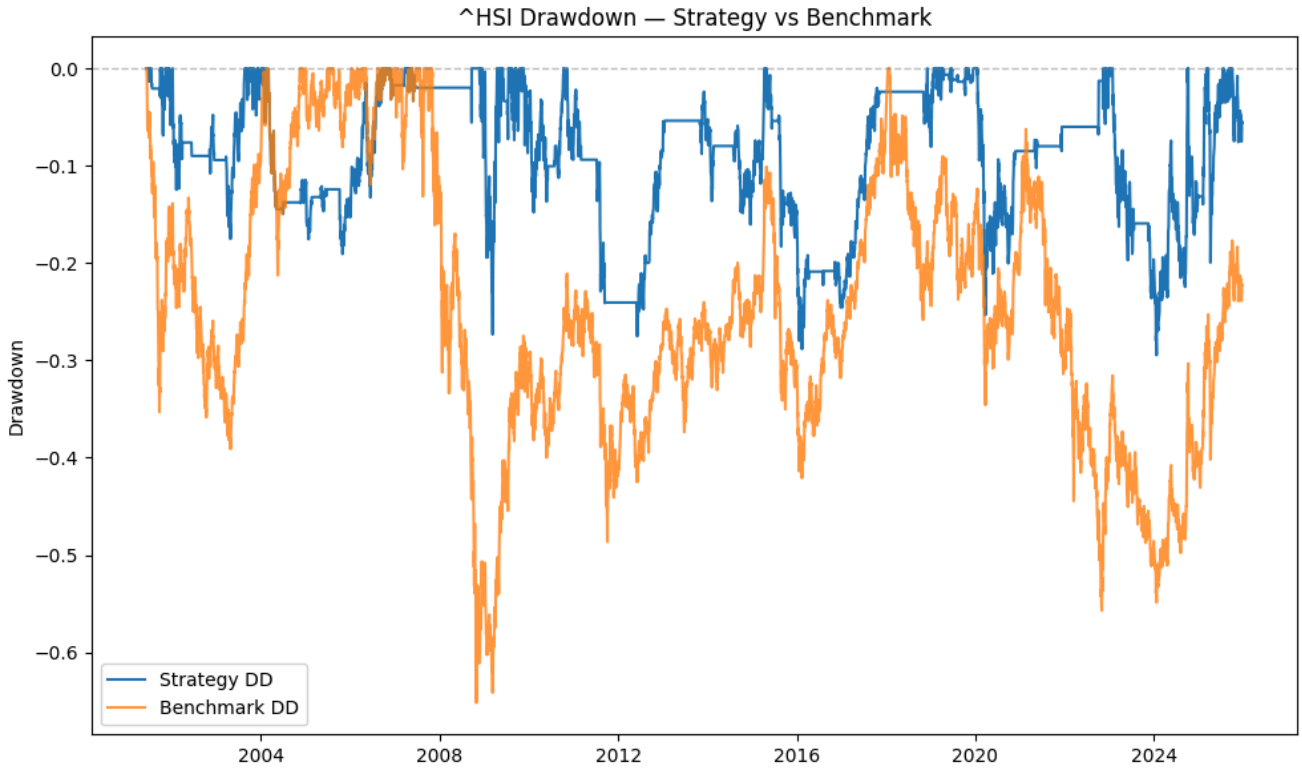
- **Figure 2:** `SS001` equity curve (Overlay vs Buy & Hold)

- **Figure 3:** `^N225` equity curve (Overlay vs Buy & Hold)



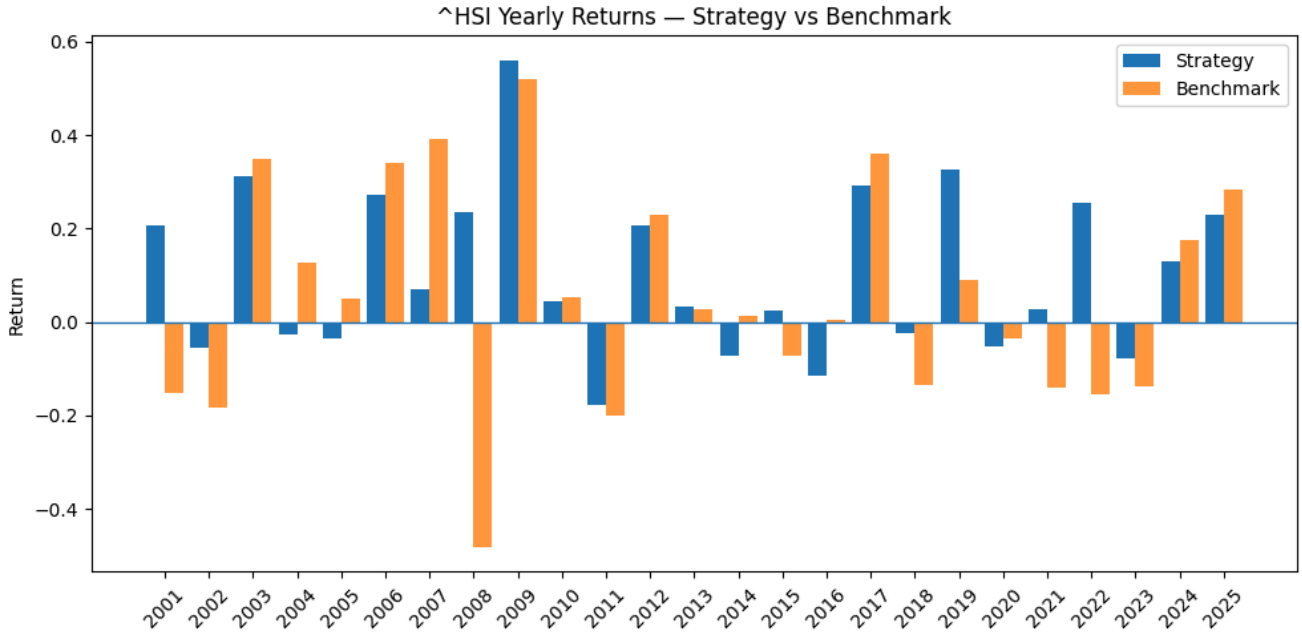
4.2 Drawdown: tail-risk behavior

- **Figure 4:** drawdown comparison for `^HSI` (Overlay vs Buy & Hold)



4.3 Year-by-year performance (attribution-friendly view)

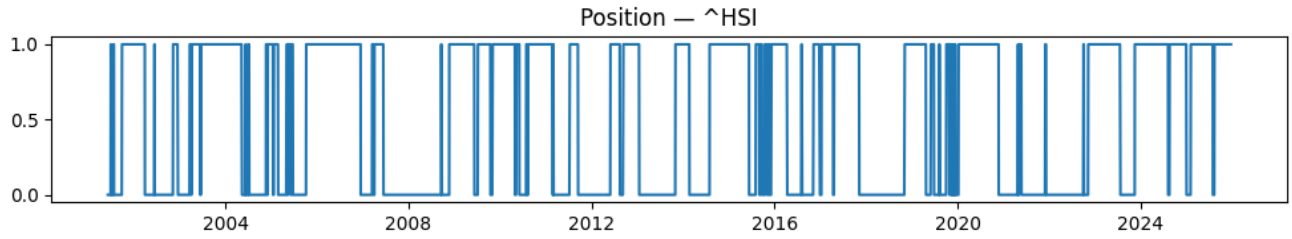
- **Figure 5:** `^HSI` yearly returns (Overlay vs Buy & Hold)



4.4 Regime decision timeline (position state)

This figure visualizes the **final regime decision** used for exposure control: **ON (1)** vs **OFF (0)**.

- **Figure 6:** `^HSI` position state over time (ON=1, OFF=0)



5. Table A — Regime State Separation (Primary Indices)

Table A summarizes how return/risk characteristics differ between OFF and ON regimes.
This table focuses on the primary indices shown in the figures: `^HSI` , `SS001` , and `^N225` .

Table A. ON vs OFF regime statistics

Market	State	Days	Ann. Ret	Ann. Vol	Sharpe	Max DD (in state)	ON Share	Flips/Yr
^HSI	OFF	2721	-10.9%	25.3%	-0.43	-81.6%	0.54	4.8
^HSI	ON	3161	19.7%	21.8%	0.90	-31.0%	0.54	4.8
SS001	OFF	2598	-13.4%	25.3%	-0.53	-86.4%	0.54	4.8

Market	State	Days	Ann. Ret	Ann. Vol	Sharpe	Max DD (in state)	ON Share	Flips/Yr
SS001	ON	3007	21.8%	23.1%	0.94	-38.0%	0.54	4.8
^N225	OFF	2562	-5.2%	24.9%	-0.21	-79.9%	0.54	4.8
^N225	ON	2972	21.4%	23.6%	0.91	-31.1%	0.54	4.8

Interpretation

- Across Hong Kong, China, and Japan, ON regimes are associated with **positive annualized returns and materially higher Sharpe**, while OFF regimes are associated with **negative or substantially weaker outcomes**.
- ON share is approximately **0.53–0.54**, and flip frequency is approximately **4–5 per year**, consistent with a **macro-frequency overlay** rather than high-turnover timing.

6. Tail-Risk Evidence: Worst-Day Loss Reduction

This section evaluates whether the overlay meaningfully reduces losses during the market's worst days—an explicit test of the strategy's risk-control mechanism.

6.1 Table B — Worst-day loss reduction (q = 1%, 5%)

Table B. Worst-day loss reduction

Definition (worst-day quantiles): for each market, "worst q% days" are identified using the **buy-and-hold daily returns** over the full sample. The overlay strategy return is then evaluated **on those same dates**. The overlay follows a realistic timing convention: the regime decision observed at time *t* affects exposure from *t+1* onward.

Market	q	Avg BH (worst)	Avg Overlay (worst)	Capture Ratio	Avg Exposure (worst)
^HSI	1%	-5.53%	-1.83%	0.33	0.34
^HSI	5%	-3.35%	-1.36%	0.41	0.43
^HSCE	1%	-6.78%	-1.81%	0.27	0.27
^HSCE	5%	-4.14%	-1.62%	0.39	0.41
SS001	1%	-6.26%	-2.95%	0.47	0.47
SS001	5%	-3.74%	-1.66%	0.44	0.44
CSI300	1%	-7.59%	-4.76%	0.63	0.58
CSI300	5%	-3.99%	-2.02%	0.50	0.46

6.2 How to read Table B

- **Avg BH (worst):** the average buy-and-hold return on the **worst q% days** (worst days are selected by ranking BH daily returns from lowest to highest).
- **Avg Overlay (worst):** the overlay strategy's average return on that **same set of worst days**.
- **Capture Ratio:** `Avg Overlay (worst) / Avg BH (worst)` ; **smaller is better** (values **< 1** indicate the overlay reduces exposure to tail-loss days).
- **Avg Exposure (worst):** the overlay's average absolute exposure on those worst days (lower values indicate more effective de-risking when tail events hit).

Key takeaway The overlay substantially reduces losses on the worst 1%–5% days across the tested markets, supporting the view that the performance improvement is driven primarily by **tail-risk mitigation** rather than return chasing.

7. Mechanism Evidence and Risk Management Interpretation

7.1 Primary mechanism: tail-risk mitigation

The strongest evidence for the overlay's edge is the combination of:

1. clear state separation (Table A), and
2. reduced exposure and smaller losses in the worst-tail windows (Table B).

This is consistent with the overlay acting as a **macro-frequency drawdown control layer**.

7.2 How to position the overlay in a portfolio

The overlay is best treated as a **top-level risk control module**, rather than a standalone alpha engine. Practical integrations include:

- applying it to a baseline long-only exposure, or
- using it as a cap on risk allocation in broader systematic portfolios.

8. Boundary Conditions and Failure Modes

The overlay is not designed to be optimal in all regimes. Its core limitation is that **macro proxies are slow-moving** relative to certain shock types.

8.1 When it tends to work

- multi-month macro trend environments where risk appetite evolves gradually,
- drawdowns driven by macro deterioration rather than single-day discontinuities.

8.2 When it can fail (and why)

Failures concentrate in **event-driven and policy-driven shocks**, where large discontinuous moves can occur while the regime remains ON. Common categories include:

- **trade and tariff escalation** episodes (rapid repricing of growth and risk premia),
- **domestic policy pivots** that reset expectations abruptly,
- **pandemic-style shocks** (gap moves, liquidity stress),
- fast geopolitical escalations.

In these scenarios, the market may reprice faster than a macro regime proxy can update, causing **late de-risking**.

8.3 How failures should be communicated (interpretability)

A clean interpretability approach is to document a small set of widely-known macro episodes and show:

- the regime state (ON/OFF) during the episode window,
- whether worst-tail loss reduction was achieved,
- failure examples where large down days occurred while ON, tied to the episode's shock narrative.

This explains "why it failed here" without introducing a second signal.

9. Conclusion

Across multiple major equity indices, a Copper/Oil-driven regime overlay provides a robust macro-frequency exposure control layer, improving risk-adjusted outcomes primarily through tail-loss reduction, while remaining vulnerable to fast, event-driven policy shocks.

One-line summary:
A Copper/Oil macro regime overlay improves long-only index exposure outcomes mainly by mitigating tail losses, but can lag in abrupt event-driven repricing regimes.