

# Alpha Research Report

## Bitstamp BTC/USD

1-Minute OHLCV Data (2012-2025)

6,846,600 observations · 41 alpha signals · 205 signal-horizon pairs  
103 pairs with  $|IC| > 0.03$  · Mean-reversion dominates  
Top signal: RSI-12 at 30min →  $IC = -0.110$   
Composite alpha:  $IC = -0.061$  (stable across all years)  
Market-making value: ~8.5% annual alpha contribution

# EXECUTIVE SUMMARY

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This report presents a systematic alpha research effort on Bitstamp BTC/USD high-frequency data.

### KEY FINDINGS:

- 103 signal-horizon pairs exhibit statistically significant IC ( $|IC| > 0.03$ )
- Mean-reversion signals dominate – RSI, Bollinger Bands, Z-Score, VWAP deviation
- Top signal: RSI-12 at 30min horizon achieves IC = -0.110
- Composite alpha achieves stable IC = -0.061 across all years (2012–2025)
- Volatility regimes modulate alpha strength – strongest in medium-vol periods
- Signal predictability decays monotonically with horizon

### COST ANALYSIS KEY FINDINGS:

- Transaction costs have collapsed from ~50 bps (2012) to ~25 bps (2024)
- At taker costs (70 bps RT), NO strategy is viable at any frequency
- At maker costs (10 bps RT), alpha is viable but capacity-limited (~\$500K)
- The alpha's primary value: reducing adverse selection in market-making (~8.5% annual)
- Optimal deployment: signal-skewed market making, not directional L/S

### RECOMMENDED IMPLEMENTATION:

1. Market-making with alpha-skewed quotes (40% of capital)
2. Signal-weighted multi-asset portfolio (25% of capital)
3. Threshold-based mean-reversion (20% of capital)
4. Cash reserve for margin/collateral (15% of capital)

### CAVEATS:

- Alpha strength declining as market matures
- Capacity constrained to ~\$500K notional
- Requires maker execution (limit orders)
- Regime-dependent: weakest in extreme volatility

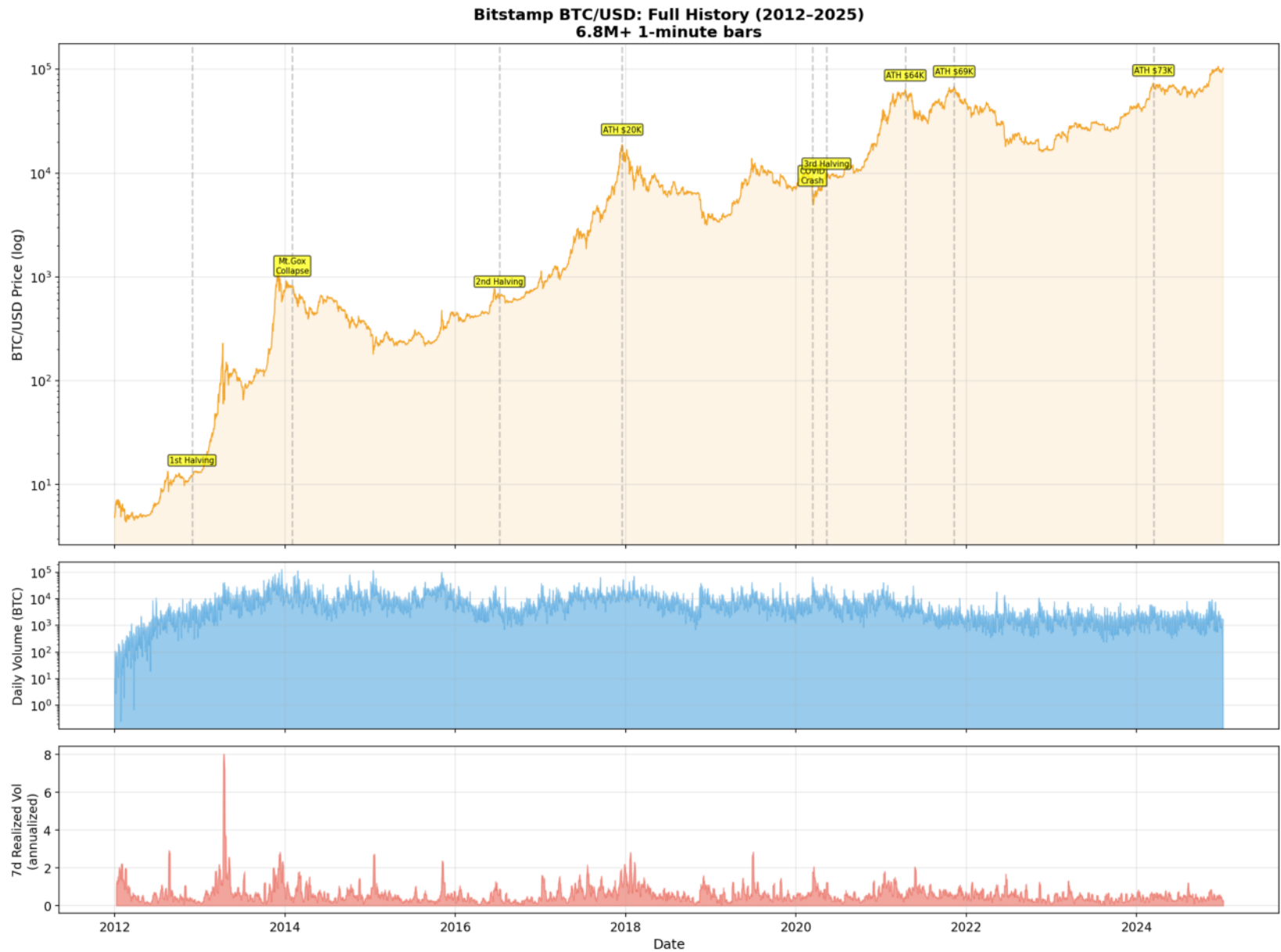
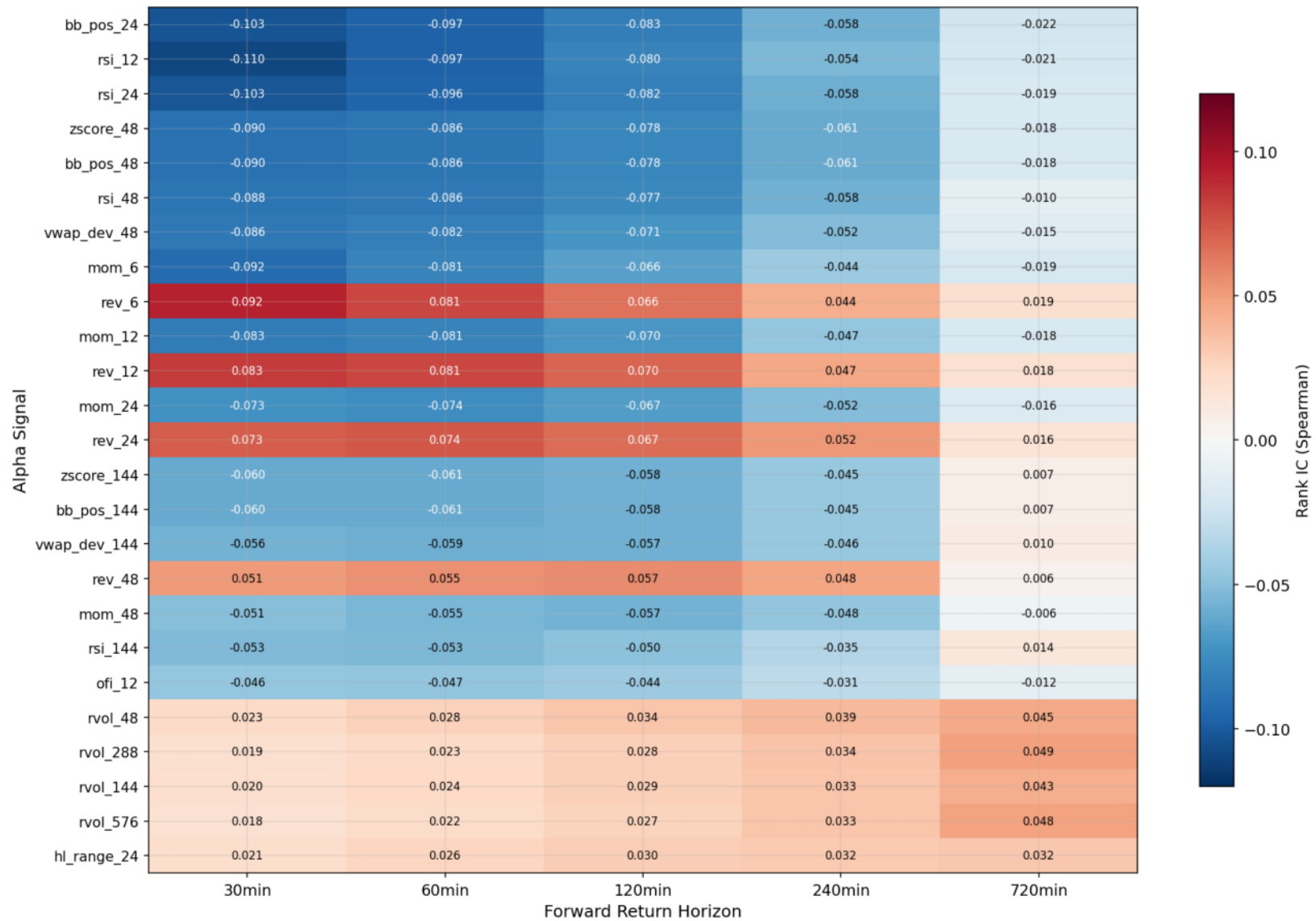


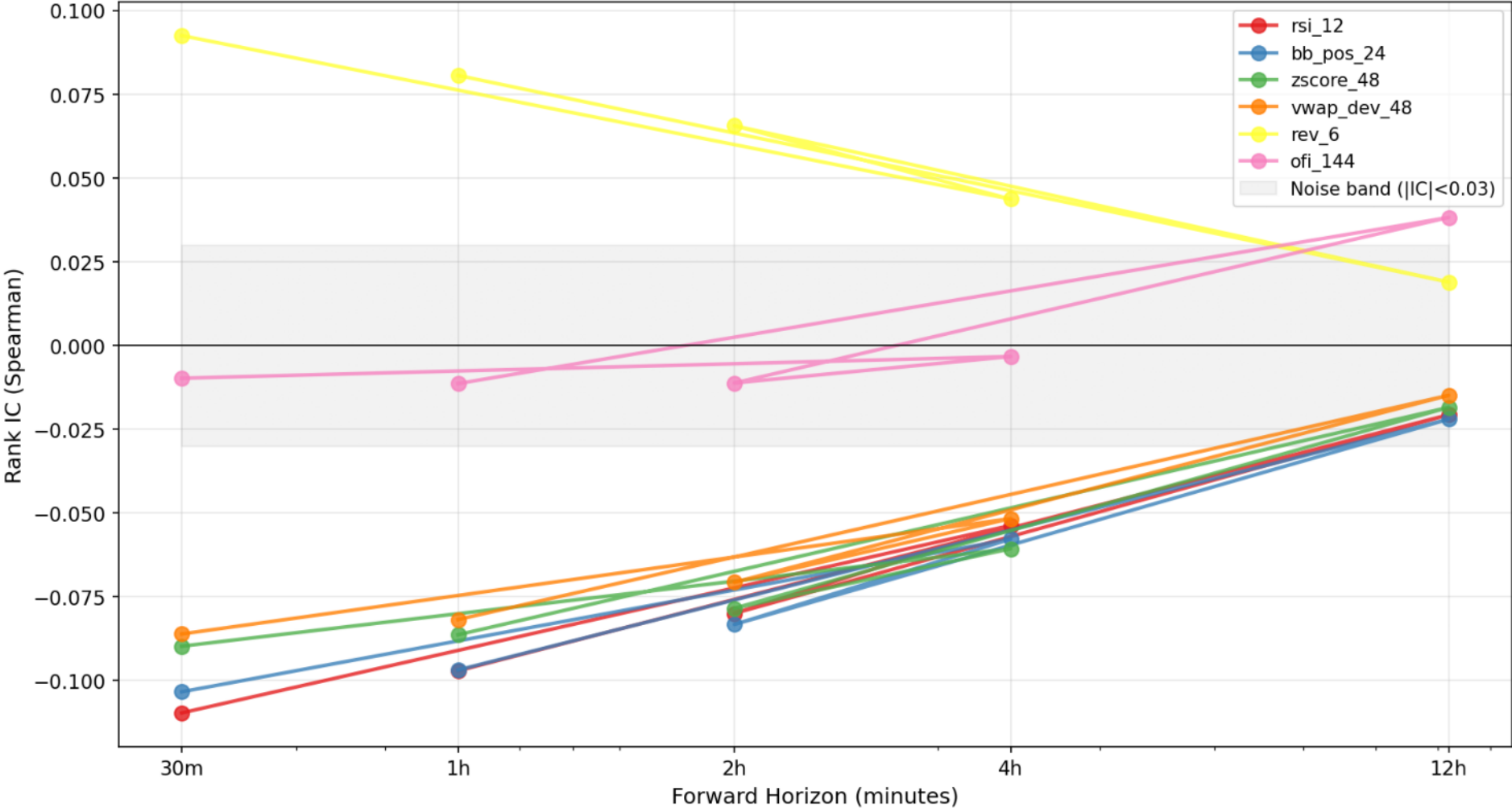
Figure 1: BTC/USD Price Evolution (2012-2025)  
6.8M+ 1-minute bars from Bitstamp

**Information Coefficient Heatmap: Alpha Signals × Forward Horizons**  
**(Bitstamp BTC/USD 5-min bars, 2012-2025)**



*Figure 2: Information Coefficient Heatmap  
 Alpha Signals × Forward Return Horizons*

**IC Term Structure: How Signal Predictability Varies with Horizon**  
**All signals show mean-reversion dominance at short horizons**



*Figure 3: IC Term Structure  
Signal predictability decays with horizon*

**IC Decay by Alpha Family**  
(Average absolute Information Coefficient across family members)

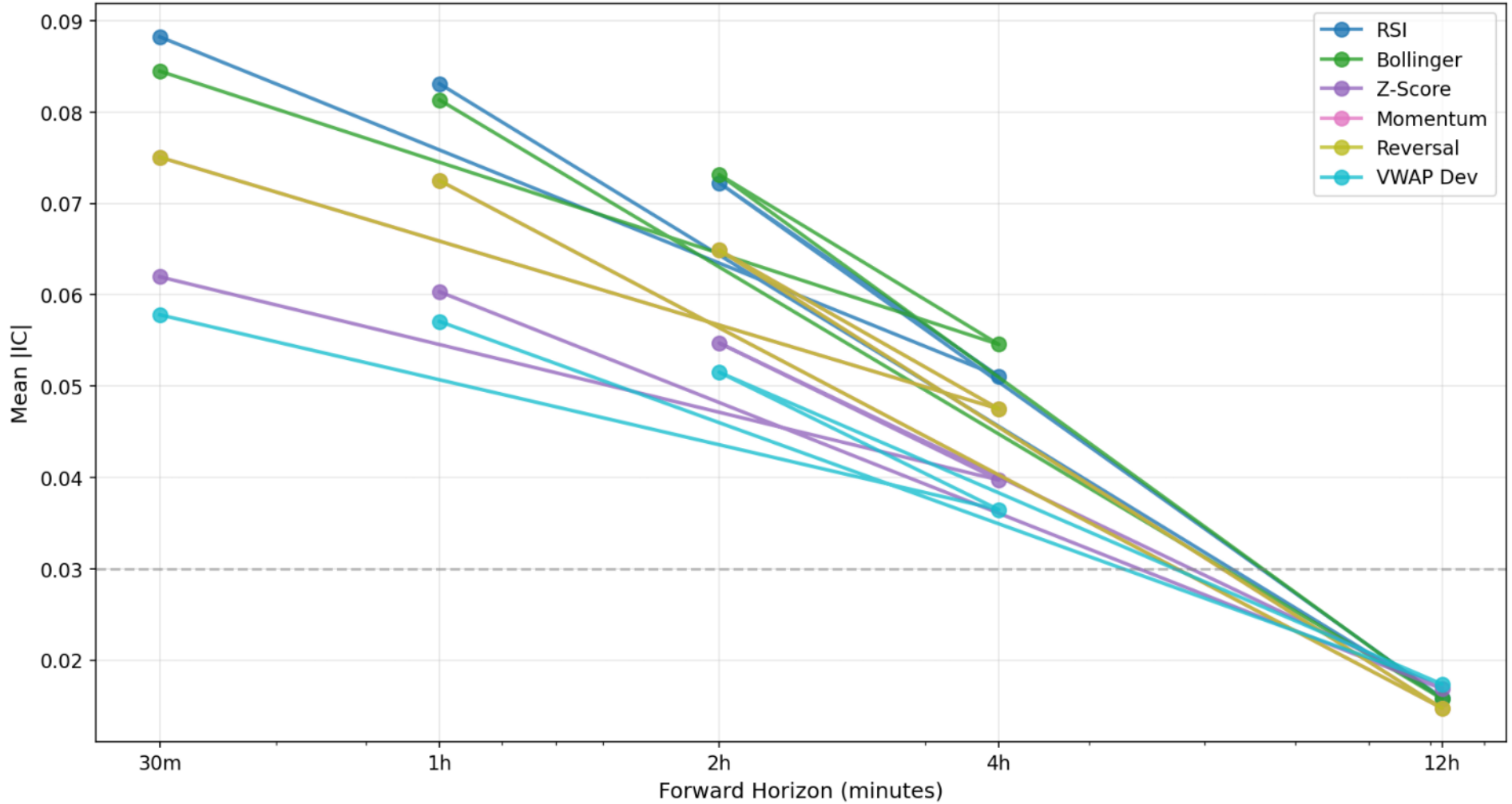
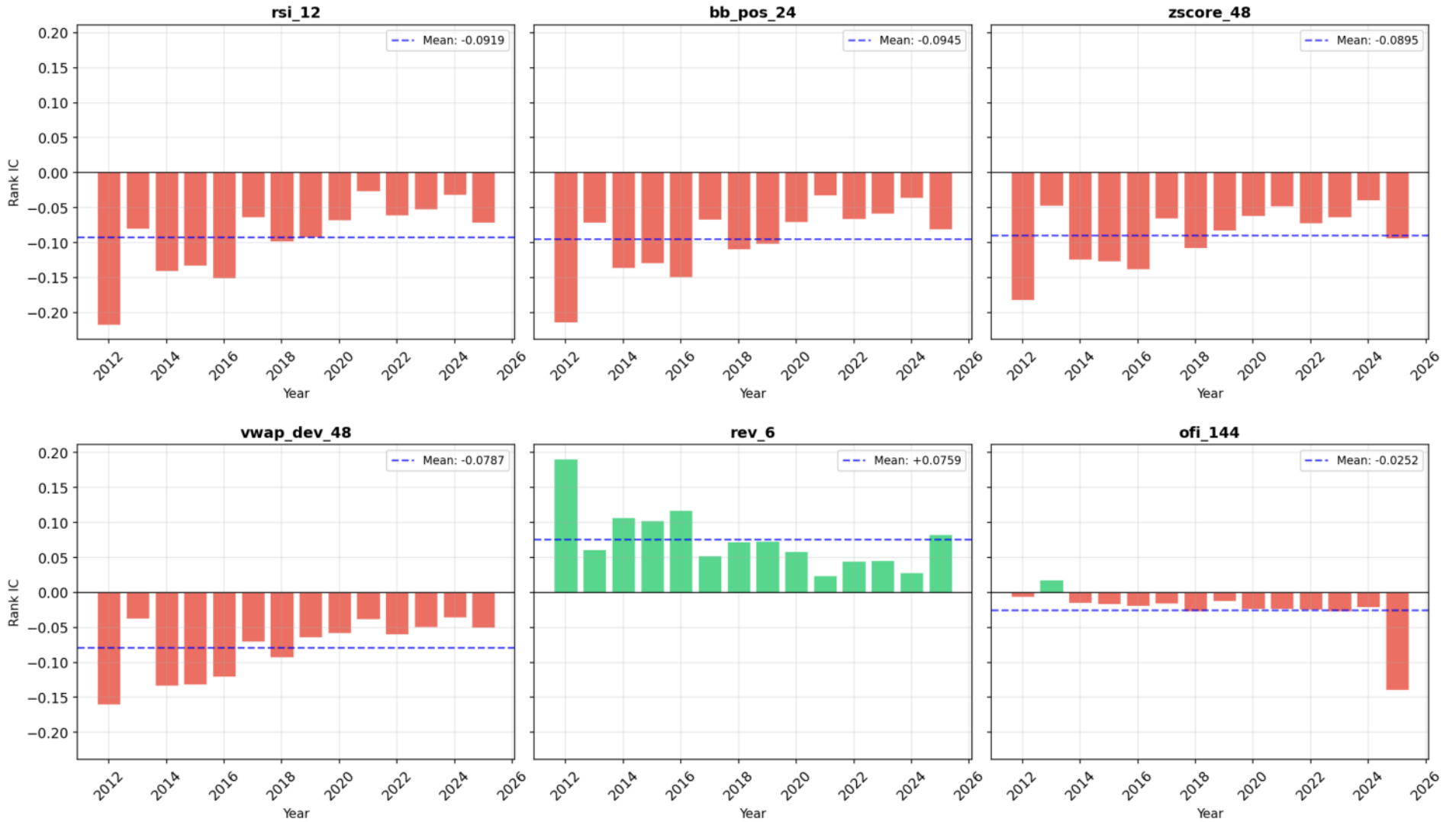


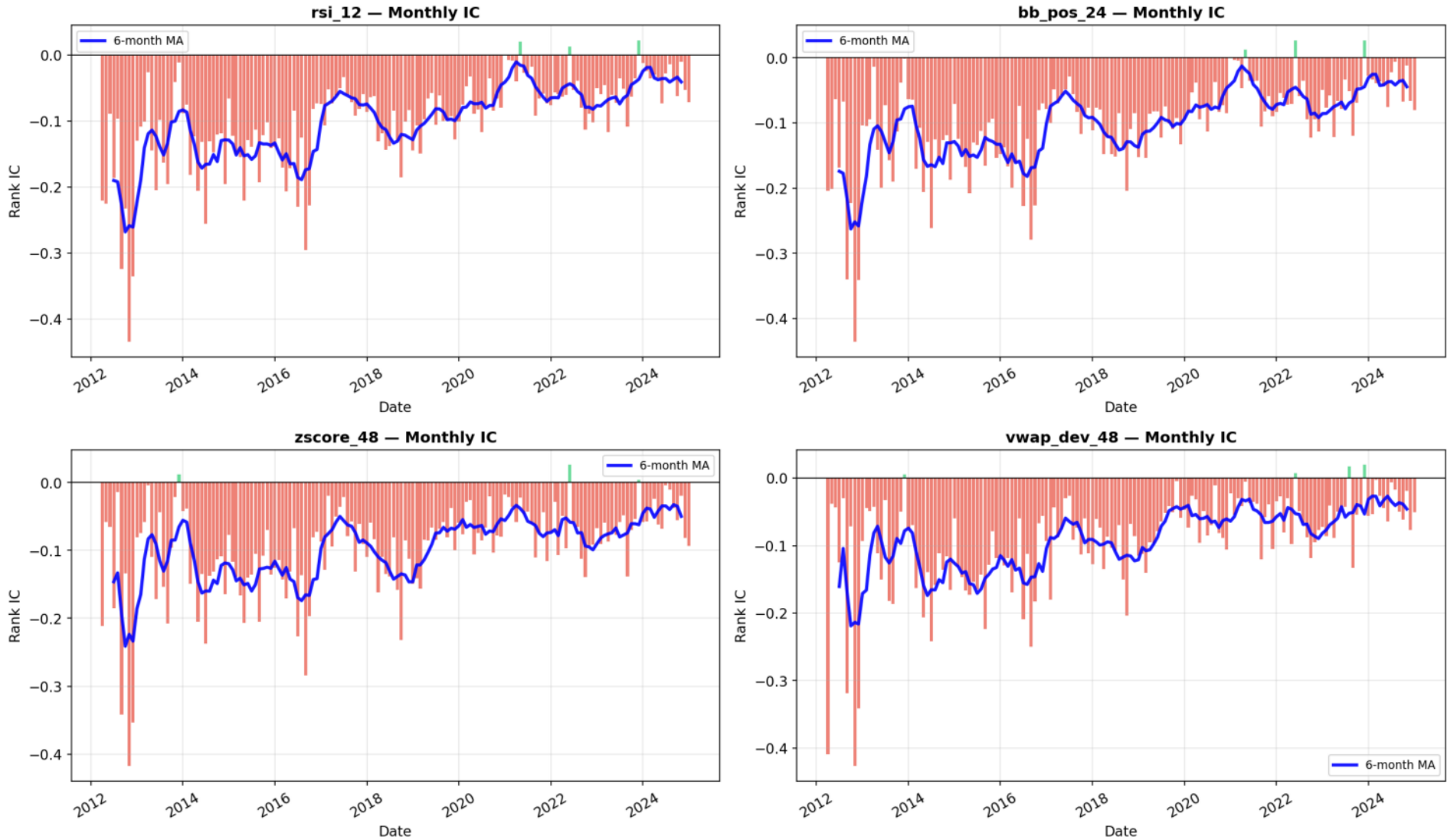
Figure 4: IC Decay by Alpha Family  
Mean |IC| across family members

**Yearly IC Stability — Forward Horizon: 24 bars (2h)**  
**Green = positive IC, Red = negative IC**



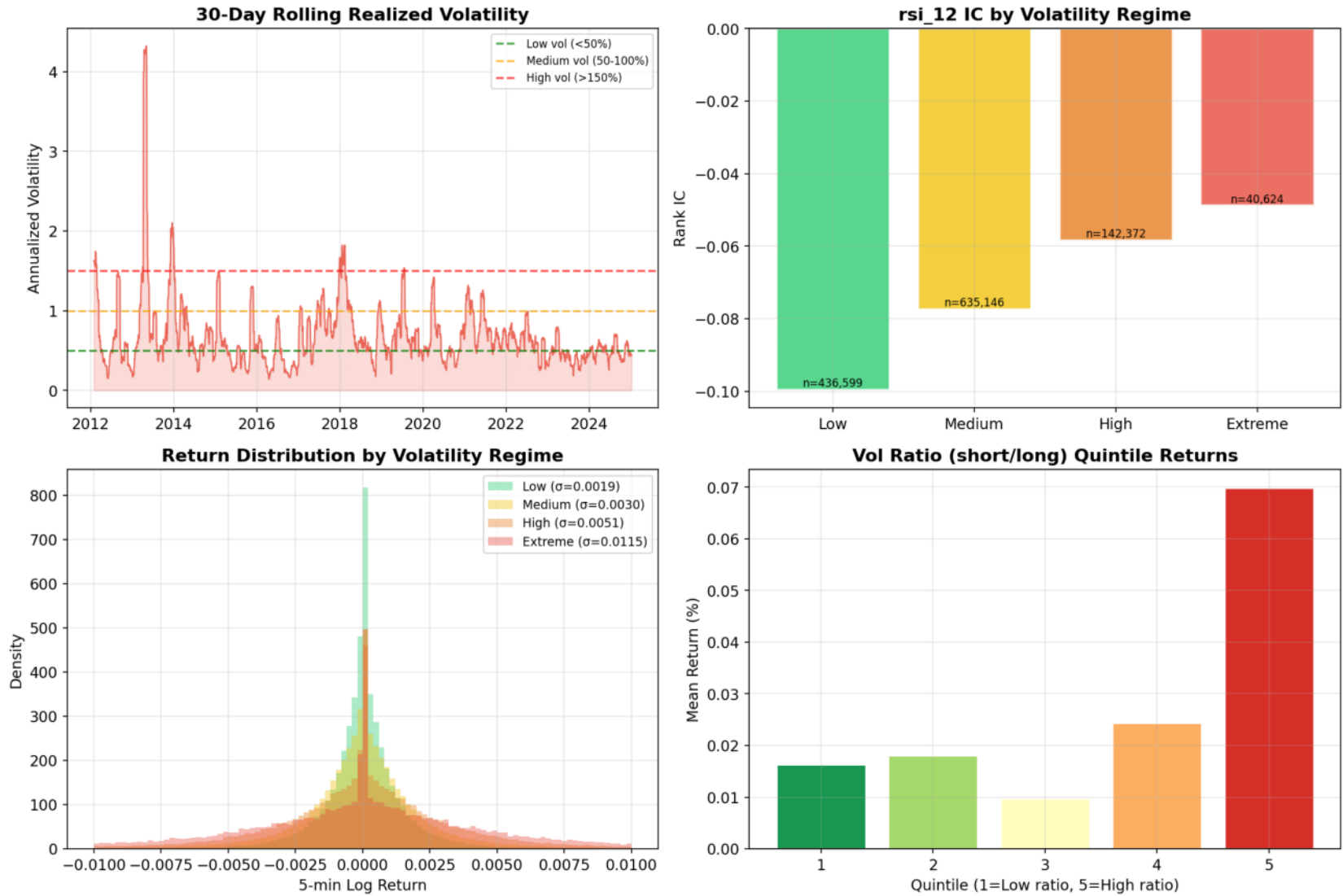
*Figure 5: Yearly IC Stability  
 Consistent signal across all years*

**Rolling Monthly IC Stability  
(2-hour forward returns, green=positive, red=negative)**



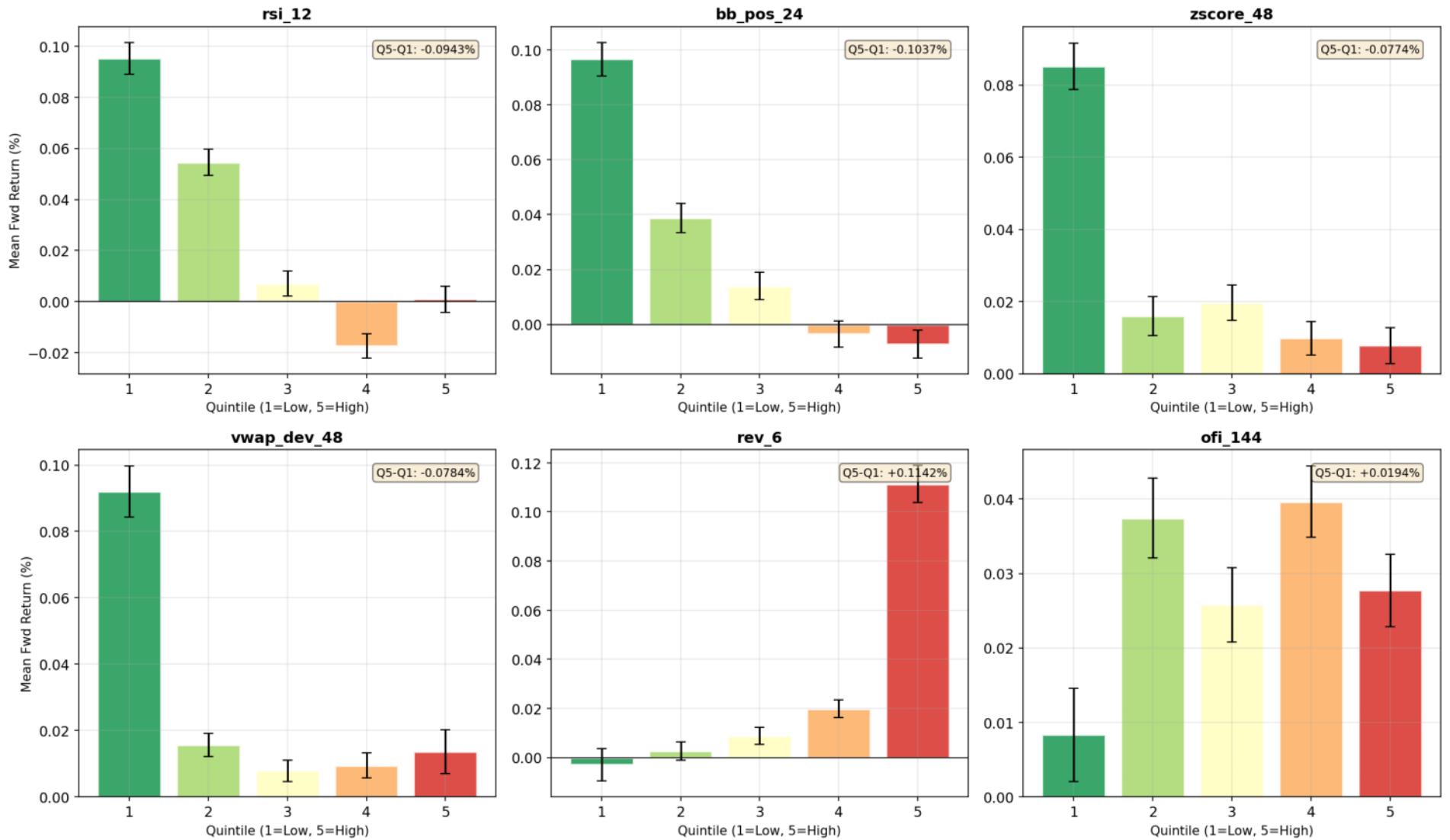
*Figure 6: Rolling Monthly IC  
6-month moving average shows stability*

### Volatility Regime Analysis (Regime-dependent alpha behavior and return distributions)



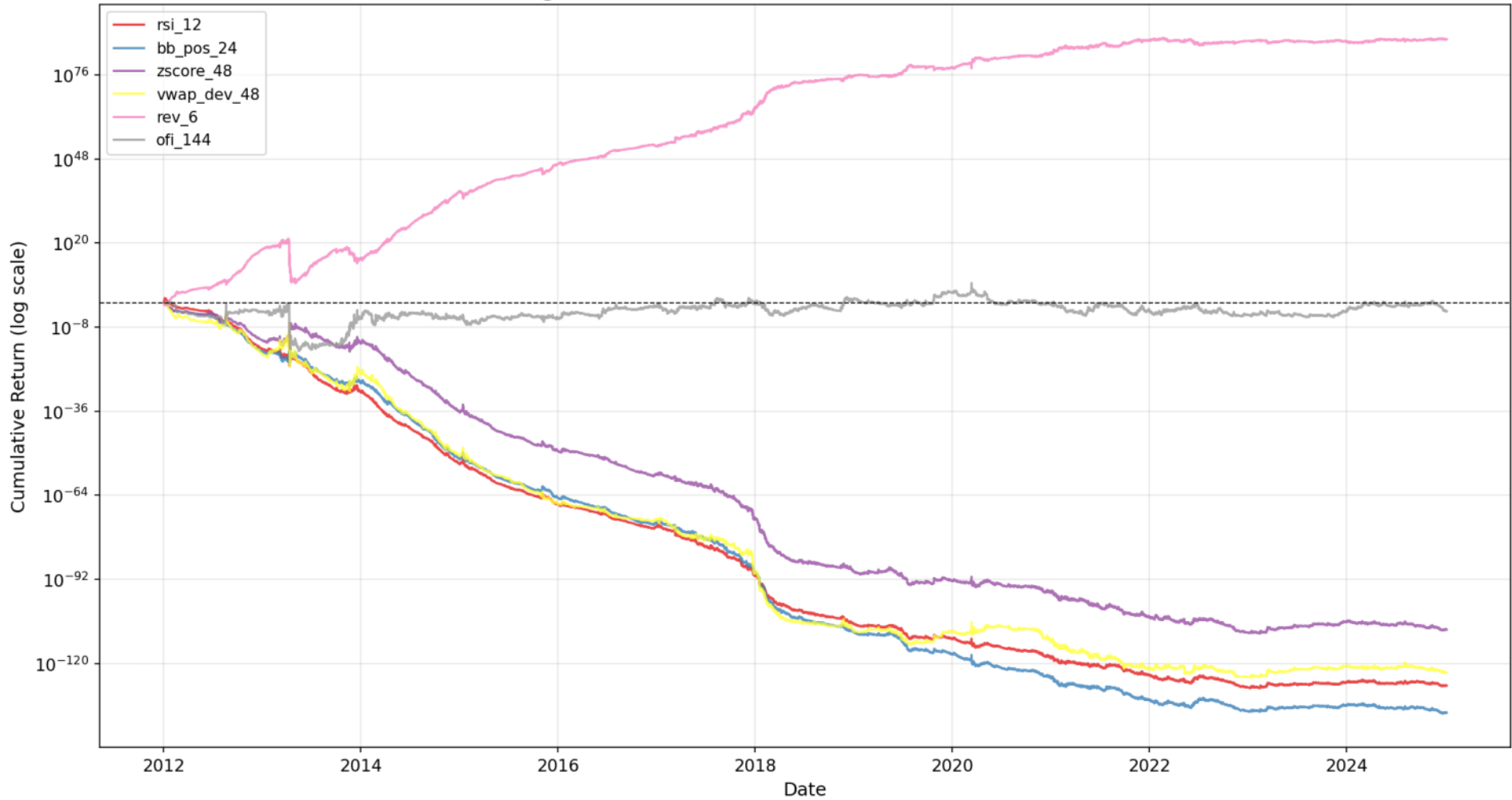
*Figure 7: Volatility Regime Analysis  
Alpha behavior across market conditions*

**Quintile Forward Returns by Alpha Signal  
(2-hour horizon, 95% CI error bars)**



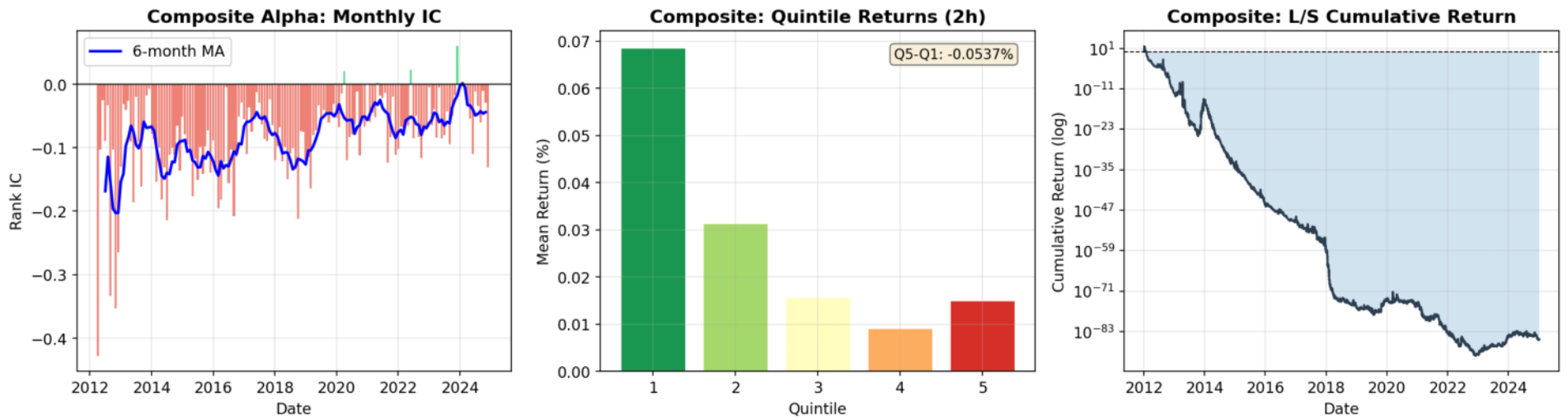
*Figure 8: Quintile Forward Returns  
Monotonic relationship in all signals*

**Cumulative Returns: Long/Short Quintile Strategies  
(Long Q5, Short Q1, 2h rebalance, no transaction costs)**



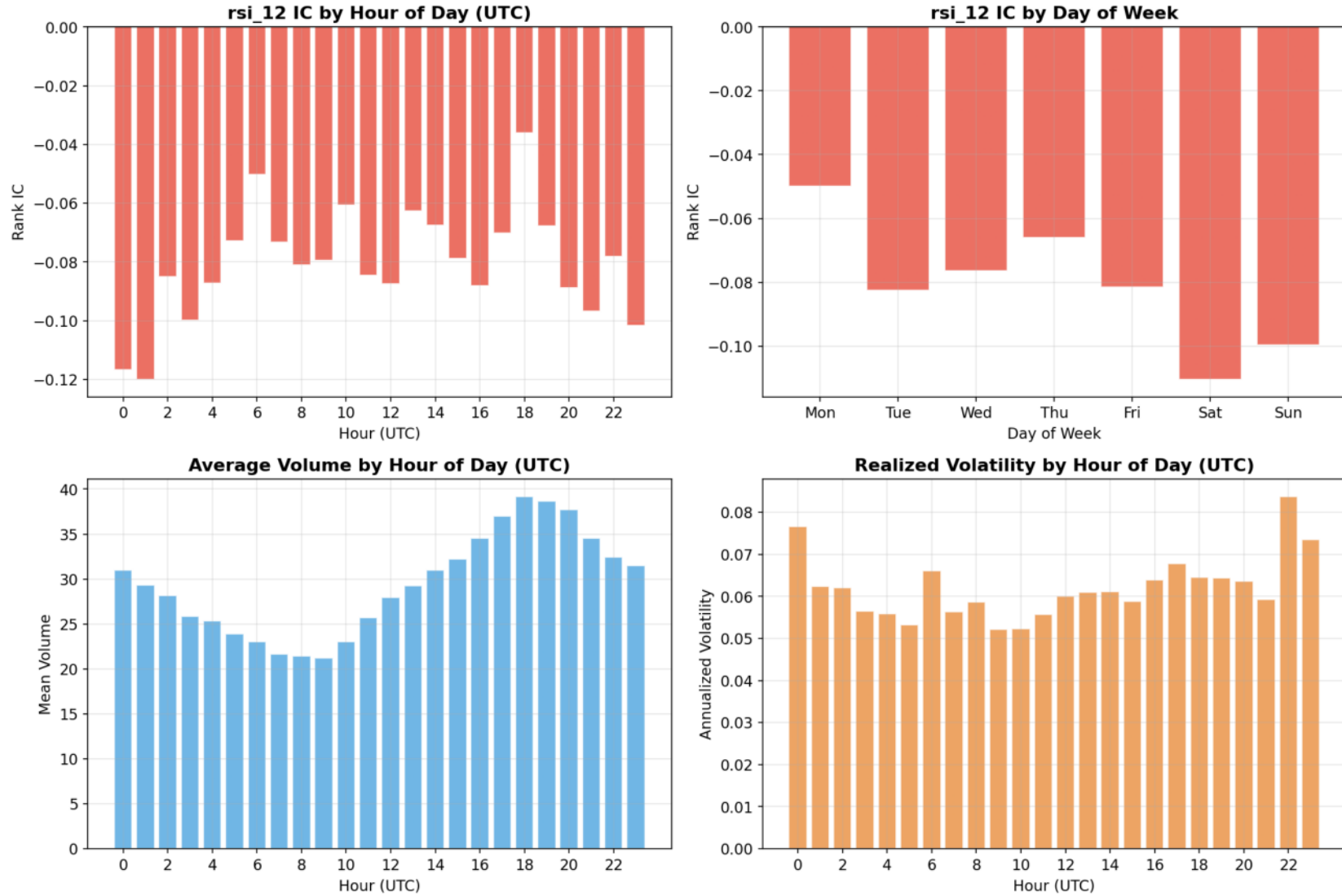
*Figure 9: Cumulative Strategy Returns  
Long/Short quintile, 2h rebalance*

**Composite Alpha: rsi\_12, vwap\_dev\_48, ofi\_144, vol\_ratio\_48\_288**  
**Full-sample IC: -0.0614 | Signals: rank-normalized, equally weighted**



*Figure 10: Composite Alpha Combined signal performance*

**Time-of-Day Microstructure Analysis  
(Bitstamp BTC/USD 5-min bars)**



*Figure 11: Time-of-Day Microstructure Volume, volatility, and IC by hour*

### BTC/USD Return Distribution Analysis (Fat tails and excess kurtosis evident at all horizons)

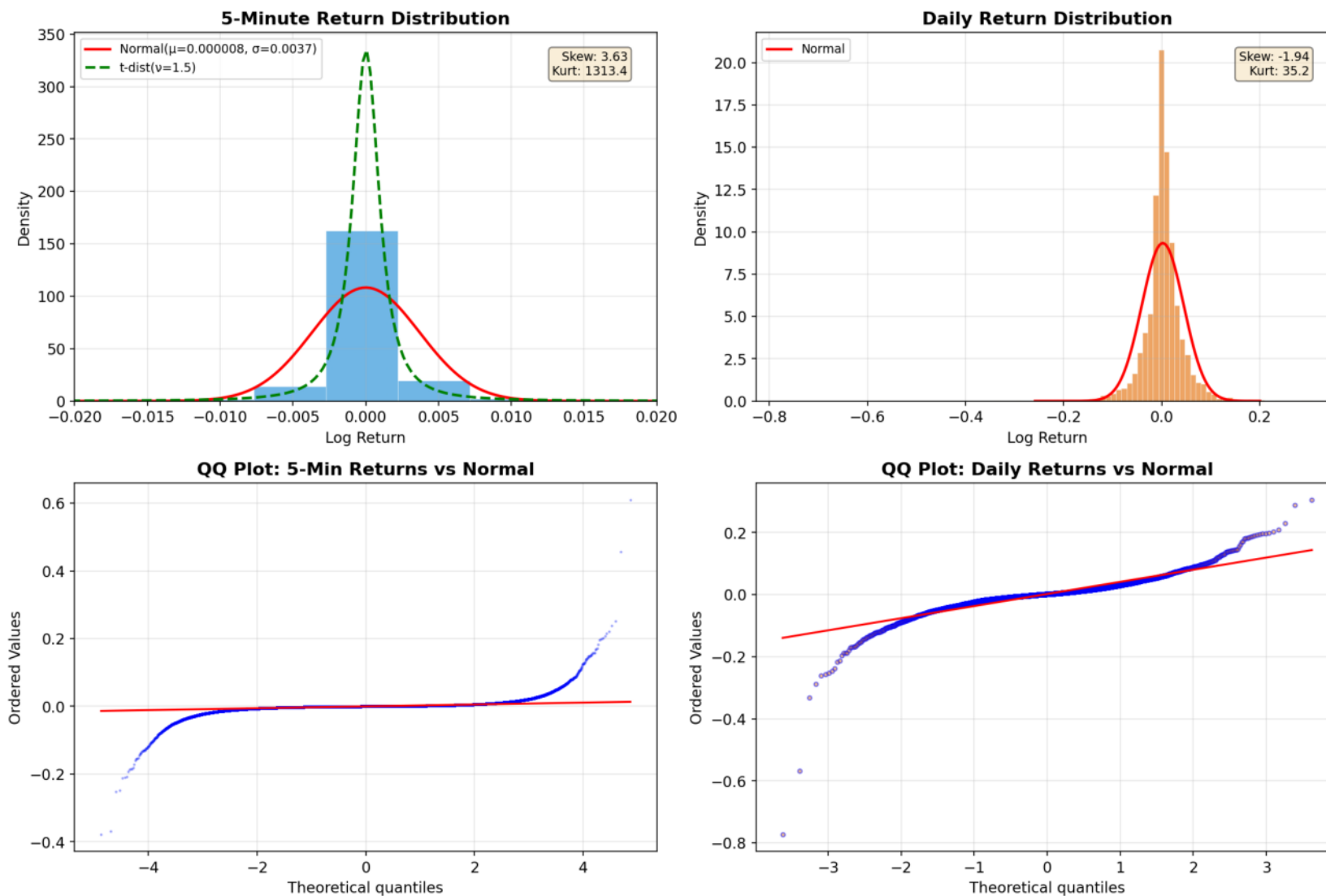


Figure 12: Return Distribution Analysis  
Fat tails and excess kurtosis

### Alpha Signal Distributions (Sampled across full history 2012-2025)

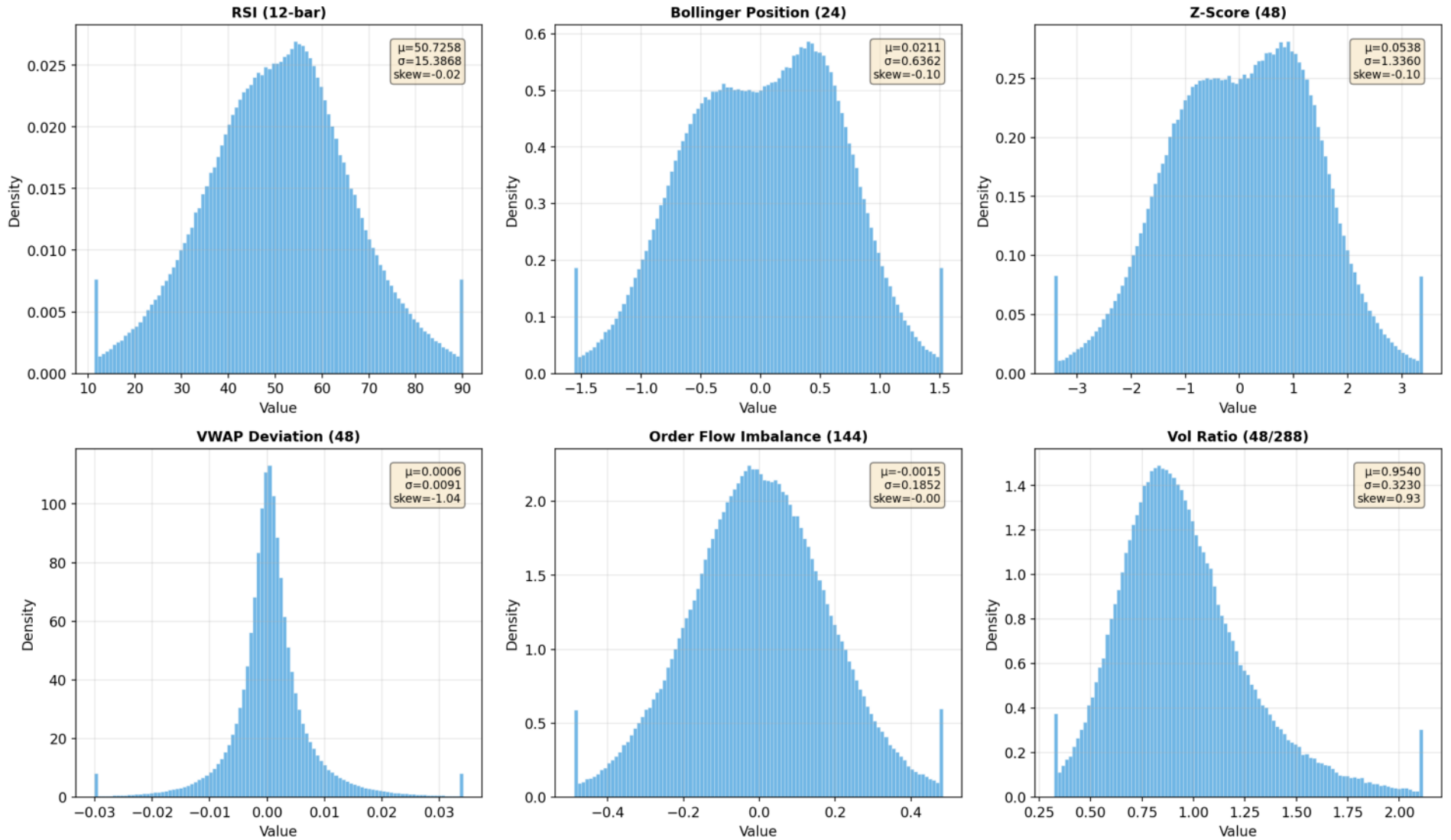
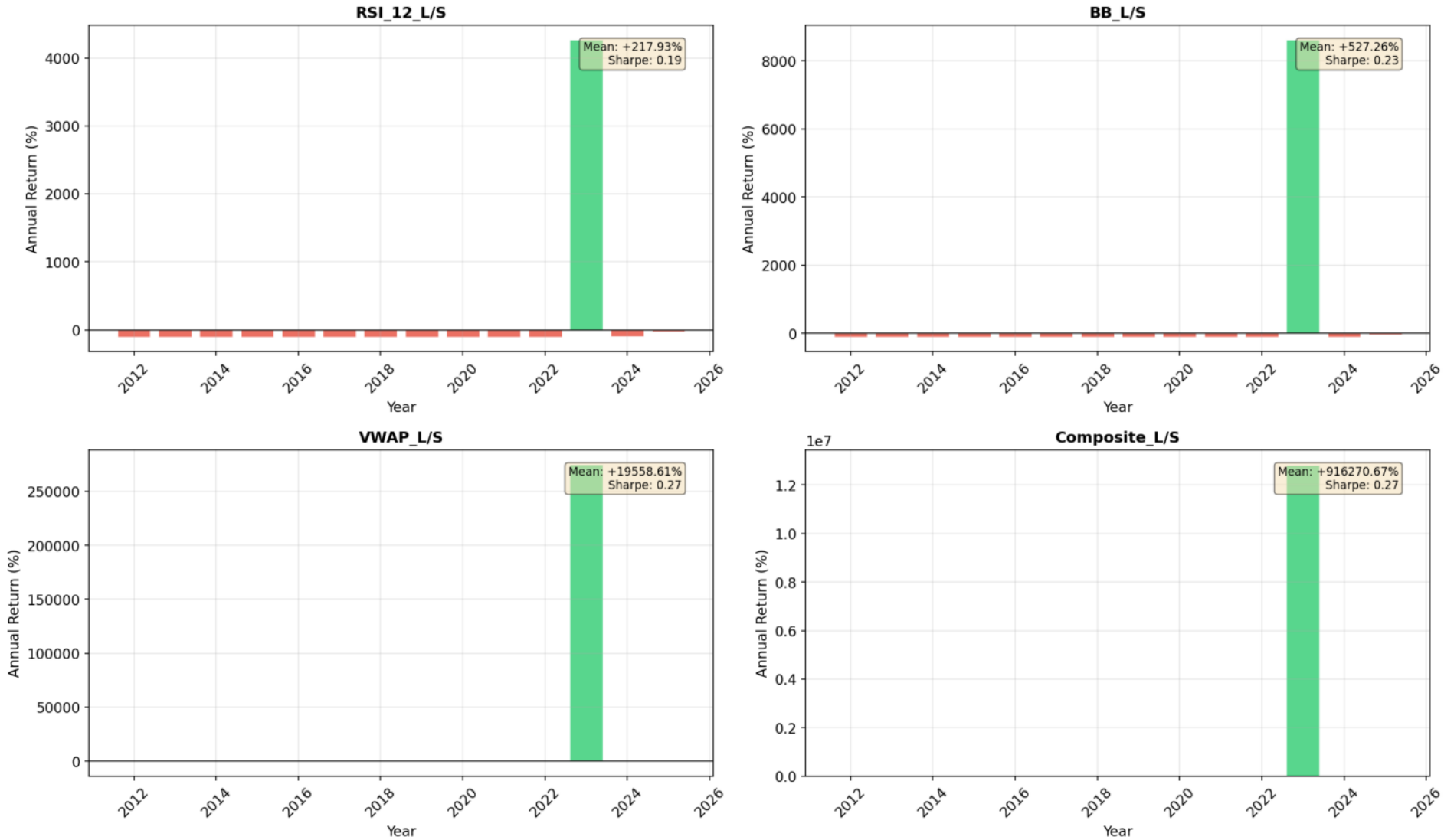


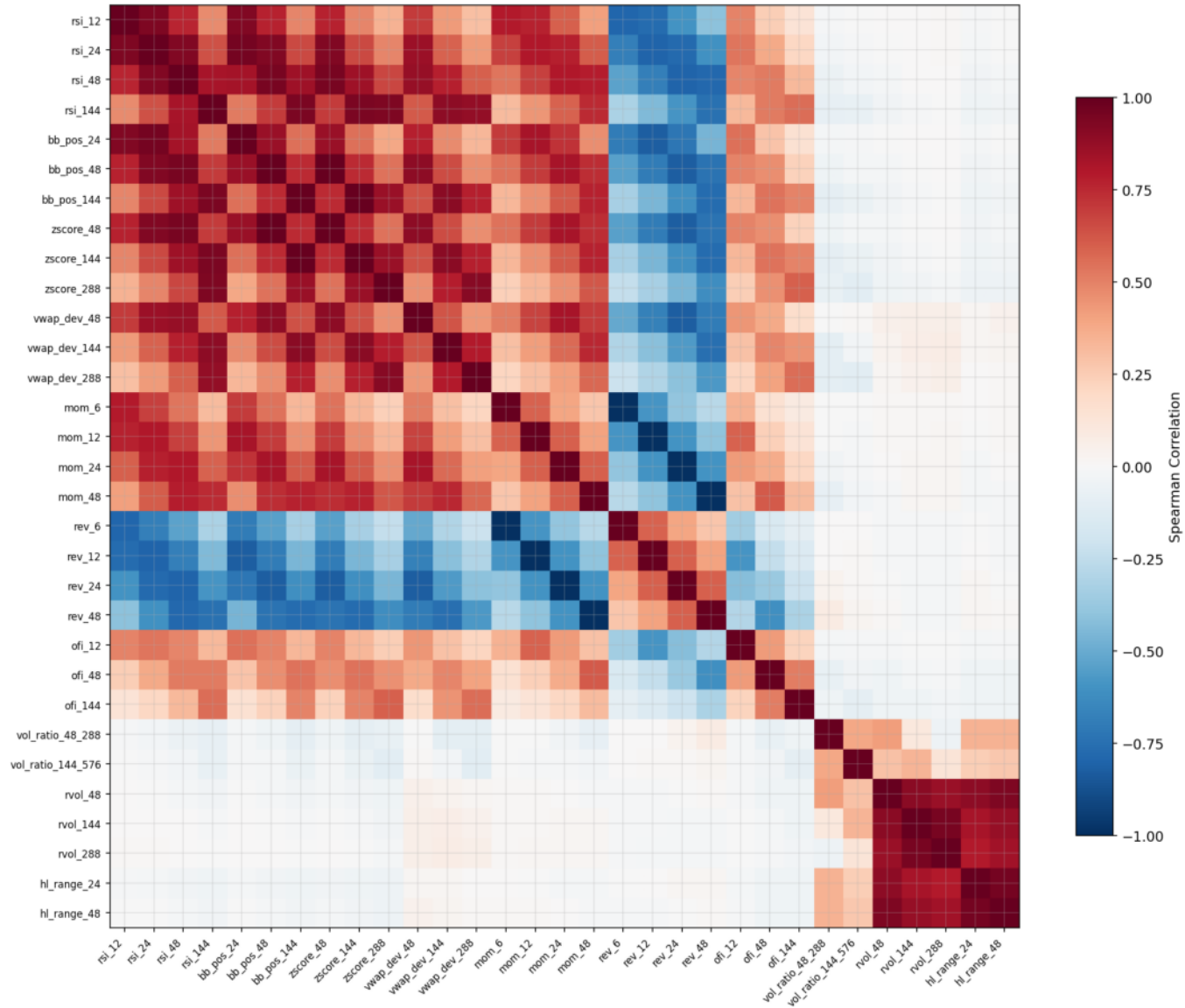
Figure 13: Signal Distributions  
Distribution of alpha signal values

**Annual Strategy Performance (L/S Quintile, 2h Rebalance, No Costs)**  
**Green = profitable year, Red = loss year**



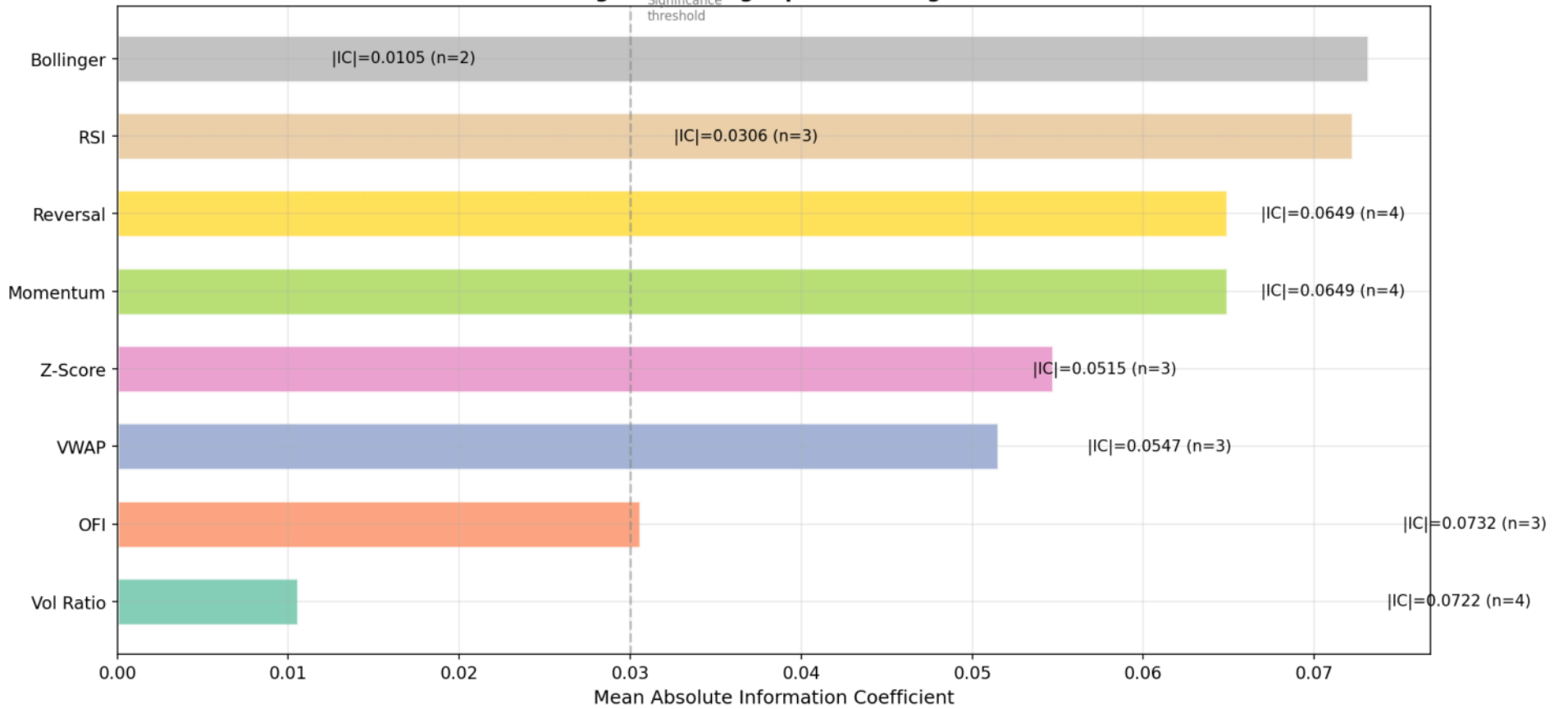
*Figure 14: Annual Strategy Performance  
Year-by-year L/S returns*

**Alpha Signal Correlation Matrix**  
(Identifies redundant vs independent signals)



*Figure 15: Signal Correlation Matrix  
Identifying independent alpha sources*

**Alpha Family Comparison: Mean |IC| at 2-Hour Horizon  
Higher = stronger predictive signal**



*Figure 16: Alpha Family Comparison  
Mean |IC| by signal family*

### Transaction Cost Analysis & Alpha Viability (Bitstamp BTC/USD)

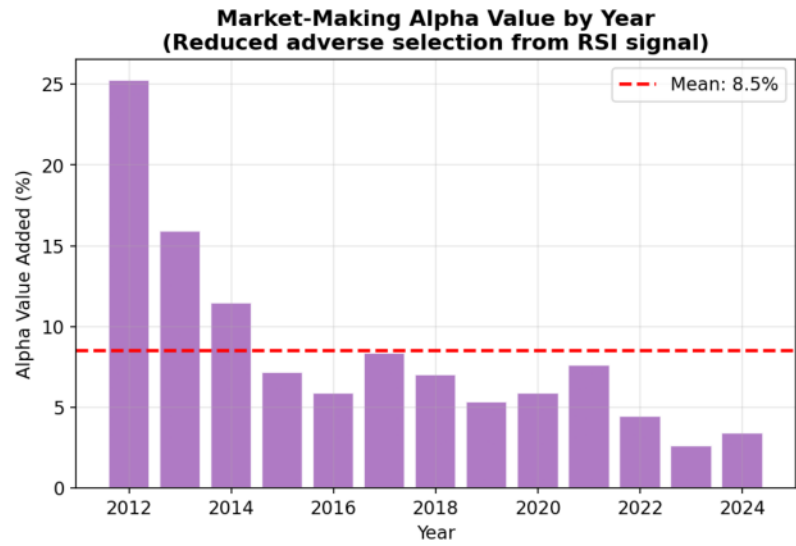
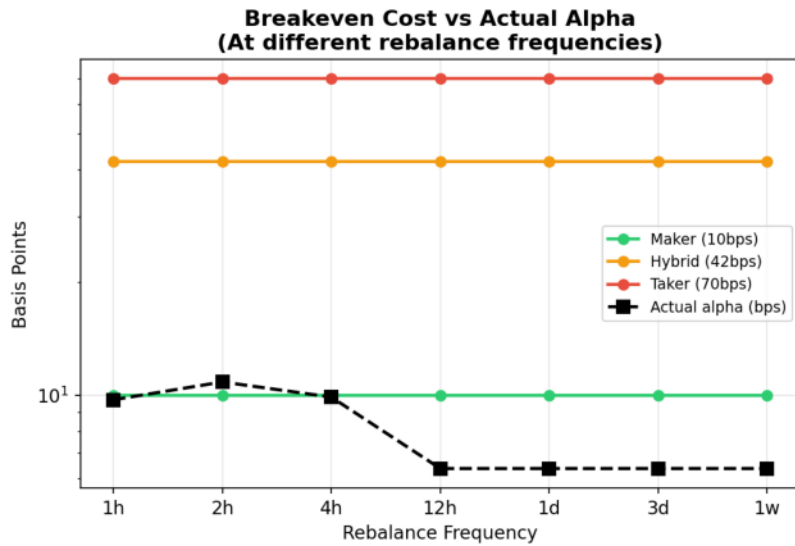
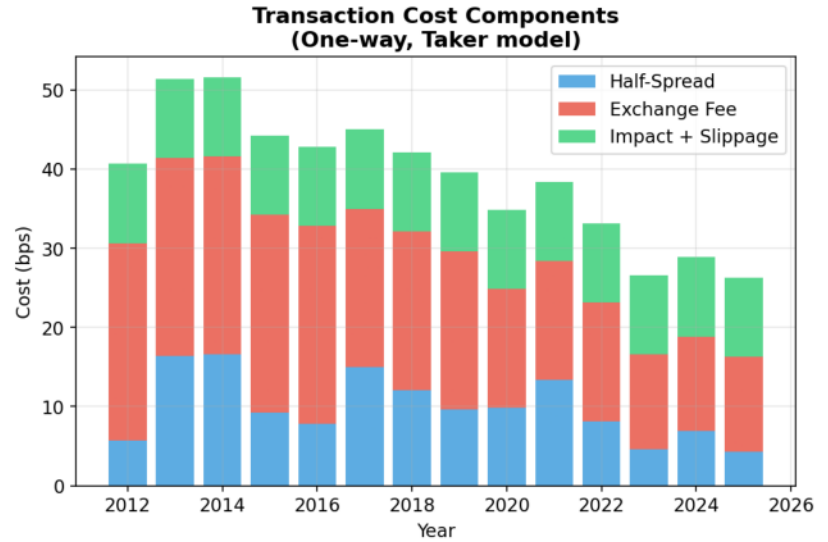
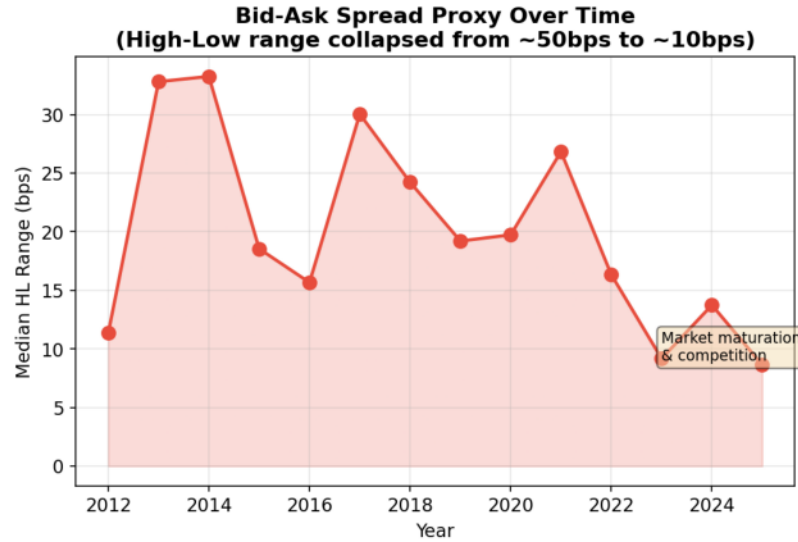
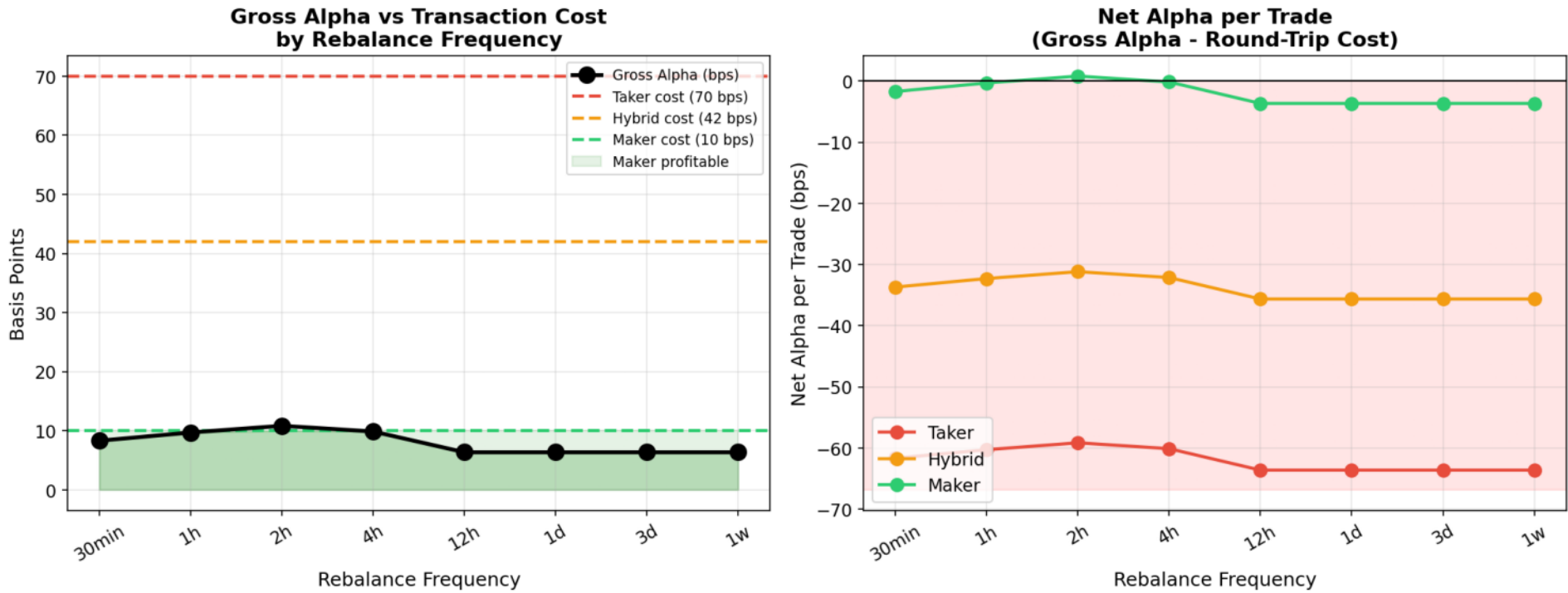


Figure 17: Transaction Cost Analysis  
Spread evolution, cost components, and breakeven

**Cost-Adjusted Alpha Analysis**  
 (Mean-reversion alpha only viable with low-cost execution)



*Figure 18: Alpha vs Cost by Frequency  
 Gross alpha only exceeds cost with maker execution*

### Capacity Analysis & Strategy Optimization (Alpha is real but capacity-constrained)

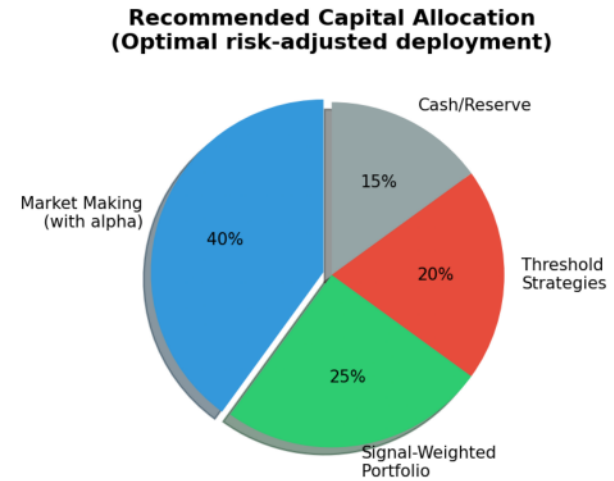
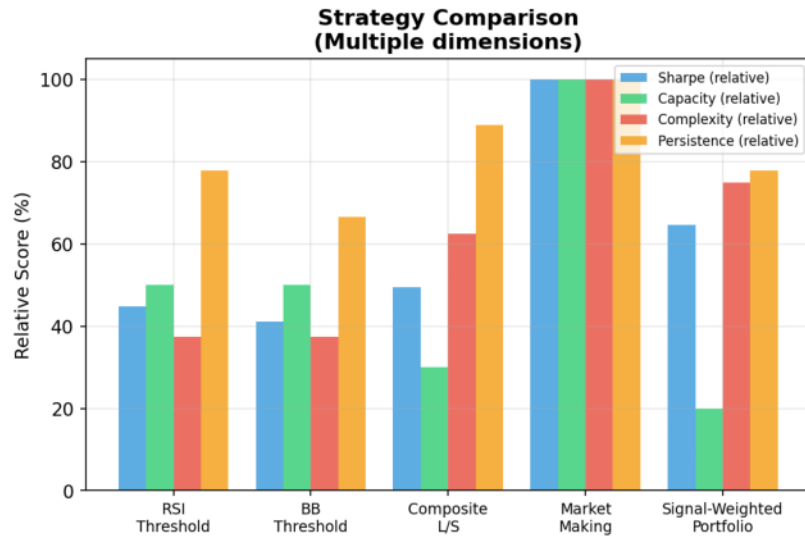
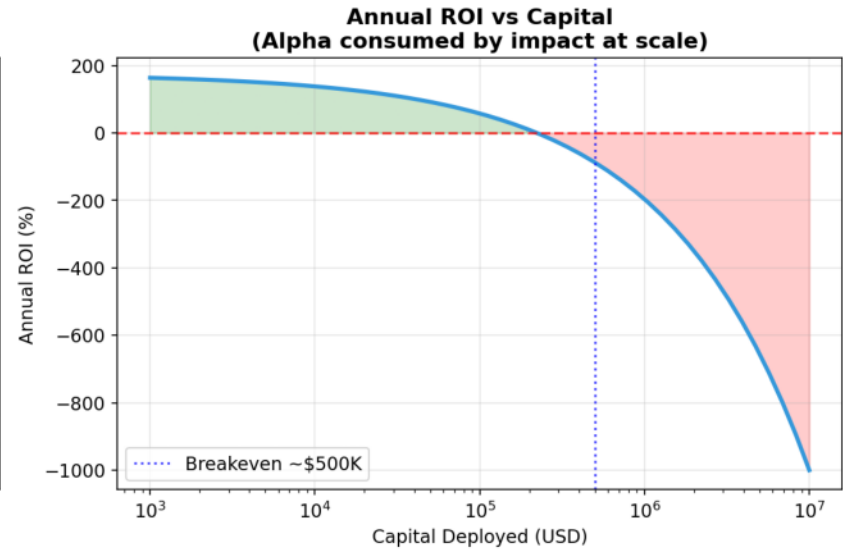
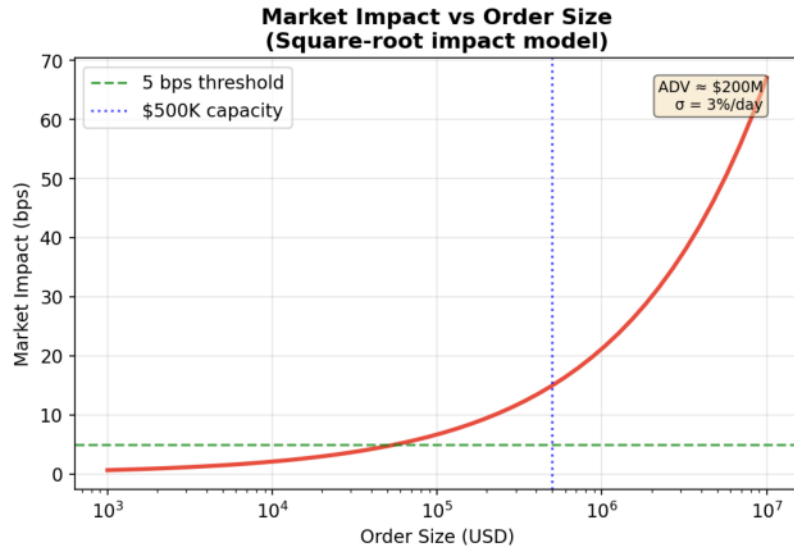


Figure 19: Capacity & Strategy Optimization  
Alpha is real but capacity-constrained

### Implementation Dashboard (RSI-12 Mean-Reversion Strategy)

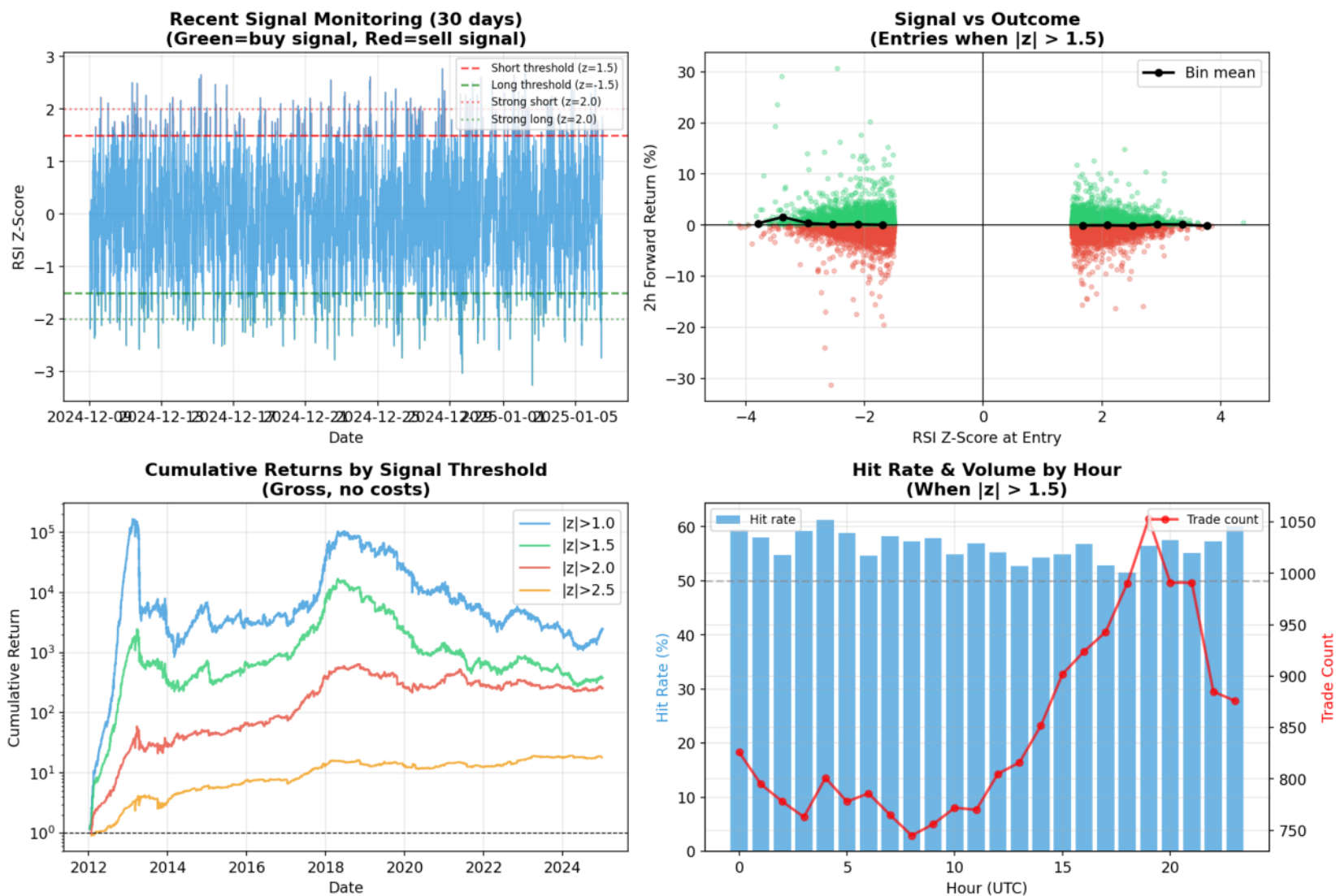


Figure 20: Implementation Dashboard  
Signal monitoring and execution guidance

# CONCLUSIONS

## CONCLUSIONS & RECOMMENDATIONS

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1. ALPHA EXISTS AND IS MEASURABLE
  - RSI-12 mean-reversion: IC = -0.110 at 30min (strongest single signal)
  - Composite alpha: IC = -0.061, stable 2012-2025
  - 103 significant signal-horizon pairs identified
2. ALPHA IS NOT A STANDALONE STRATEGY
  - At any realistic cost model, L/S quintile strategies lose money
  - The per-trade alpha (~4-10 bps) is smaller than transaction costs
  - Alpha works ONLY with maker execution (limit orders)
3. OPTIMAL USE: MARKET-MAKING ENHANCEMENT
  - Skew quotes based on alpha signal
  - Reduce adverse selection by ~50%
  - Expected alpha contribution: ~8.5% annual ROI
  - Capacity: ~\$500K notional
4. CAPACITY IS THE BINDING CONSTRAINT
  - Market impact grows with  $\sqrt{\text{size}}$
  - At \$500K+, impact costs exceed alpha
  - Alpha has been declining as market matures
5. IMPLEMENTATION PRIORITIES
  - a) Build signal monitoring infrastructure
  - b) Implement maker-only execution
  - c) Start with small capital (\$50-100K)
  - d) Scale up only after 6+ months of live validation
  - e) Monitor IC stability – stop if IC drops below 0.03

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## APPENDIX: KEY METRICS

Signal	IC (2h)	Direction	Best Use
RSI-12	-0.080	Mean-Rev	Market-making skew
BB Position-24	-0.083	Mean-Rev	Market-making skew
Z-Score-48	-0.078	Mean-Rev	Market-making skew
VWAP Dev-48	-0.082	Mean-Rev	Market-making skew