Momentum Strategies in Futures Markets and Trend-following Funds

Akindynos-Nikolaos (Nick) Baltas
UBS, Imperial College Business School and QMUL
n.baltas@imperial.ac.uk

Robert Kosowski
Imperial College Business School
r.kosowski@imperial.ac.uk

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Motivation

- CTA industry has significantly grown (end of 2012 AUM $329.60bn; 81% systematic).
- Historical outperformance and positive double-digit returns in 2008.
- Disappointing performance in 2009-2013. Capacity constraints?

“Capacity constraints have limited these funds in the past. [...] It’s a problem for trend-followers: the larger they get, the more difficult it is to maintain the diversity of their trading books. While equity or bond futures markets are deep and liquid, markets for most agricultural contracts -soy or wheat, for example- are less so”.

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- Hayes (2011), Arnold (2012) and Hurst, Ooi & Pedersen (2013): CTAs differ in their forecast horizons (long vs short-term)
- We combine research on momentum strategies in futures markets with research on hedge funds/CTAs and test for capacity constraints.
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Motivation - The Systematic CTA Industry (F7)

Panel A: Number of Systematic CTA Funds vs. Systematic CTA AUM

Panel B: Annual CTA Fund Flows
Main Findings - Contributions

1. In-depth analysis of time-series momentum strategies:
   - Larger cross-section (75 contracts), longer sample period (1978-2013), more frequencies (M: monthly, W: weekly, D: daily).
   - Strong momentum patterns across all trading frequencies.
   - M, W, D strategies have low cross-correlation, exhibit counter-cyclicality and cannot be explained by standard factor models.

2. CTA indices statistically and economically significantly exposed to M, W and D:
   - Inclusion of M, W, D strategies among benchmark factors for HF returns increases dramatically the explanatory power of the model.

3. No evidence of capacity constraints in time-series momentum strategies
   - Negative M, W, D performance-flow relationship, but time-varying and not significant.
   - Robust to different asset classes and consistent with liquid futures markets.
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Data

- **Futures Data**
  - Source: **TickData**
  - Daily opening/high/low/closing futures prices for 75 assets: 26 commodities, 23 equity indices, 7 currencies, 15 government bonds and 4 STIR.
  - Construct daily excess returns by rolling-over so that we always trade the most liquid contract; prices are *backwards ratio-adjusted* at a roll-over date.

- **CTA Fund data:**
  - Source: **BarclayHedge Database**
  - Monthly returns and AUM for all CTA’s trading in USD.
  - 2663 unique CTA funds (after removing duplicates); total AUM Jan. 2012 $305bn.
  - 1348 systematic CTA funds; total AUM Jan. 2012 $267bn.
  - CTA Index: (a) BarclayHedge CTA index, (b) custom-made AUM-weighted CTA index.

- **Positions of Traders:**
  - Source: **Commodity Futures Trading Commission (CFTC)**
  - Monthly open interest of futures contracts for 43 US-traded assets (out of our 75): 25 commodities, 6 equity indices, 7 currencies and 5 government bonds.
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- **Futures Data**
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  - **Dec. 1974 - Feb. 2013.**
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Serial Correlation and Return Predictability

- Assess the amount of predictability inherent in lagged monthly, weekly and daily returns.
- Pooled time-series cross-sectional regression:

\[
\frac{R(t - 1, t)}{\sigma(t - 1; 60)} = \alpha + \beta\lambda \frac{R(t - \lambda - 1, t - \lambda)}{\sigma(t - \lambda - 1; 60)} + \epsilon(t)
\]

- Returns are risk adjusted by the 60-day volatility so that pooling of the returns is admissible.
- Quantity of interest: \( t \)-statistic of \( \beta\lambda \) for each lag \( \lambda = 1, 2, \ldots, 60 \) months, weeks, days.
- \( t \)-statistics are computed using standard errors clustered by time and asset (Petersen 2009, Gow, Ormazabal & Taylor (2010), Cameron, Gelbach & Miller 2011, Thompson 2011).
- Large and significant \( t(\beta\lambda) \) support the hypothesis of time-series return predictability.
Return Predictability (F1)

- Pooled panel regression with 2-way clustered t-statistics [Dec.1974 - Feb.2013]: 

Panel A: Monthly Frequency

Panel B: Weekly Frequency

Panel C: Daily Frequency

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Time-Series Momentum

- Construction of the return series of the *time-series momentum* strategy:

\[
R^K_J (t, t + K) = \frac{1}{N_t} \sum_{i=1}^{N_t} \text{sign} [R_i (t - J, t)] \cdot \frac{40\%}{\sigma_i (t; 60)} \cdot R_i (t, t + K),
\]

where:

- \( J, K \): Lookback and holding periods measured in months, weeks, days.
- \( N_t \): number of available assets at time \( t \).
- \( \sigma_i (t; 60) \): 60-day estimate at time \( t \) of the realized volatility of the \( i^{th} \) asset.
- \( 1/K^{th} \) of the portfolio is rebalanced every month/week/day following Jegadeesh & Titman’s (2001) overlapping methodology.

- Evaluate momentum profitability for a grid of lookback (\( J \)) and investment periods (\( K \)) across various trading frequencies:
  
  - Monthly strategies with \( K, J \in \{1, 3, 6, 9, 12, 24, 36\} \) months.
  - Weekly (Wed-to-Wed) strategies with \( K, J \in \{1, 2, 4, 6, 8, 12, 26\} \) weeks.
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Refer to the paper for other statistics (average return, alpha etc.) and subsample analysis; the patterns persist.

Nick Baltas (UBS, Imperial College, QMUL)
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Trend-Following Historical Performance (F2)

Panel A: Cumulative Returns (starting at $100)

Panel B: 36-month Rolling Sharpe Ratio

Nick Baltas (UBS, Imperial College, QMUL)
### Comparison of FTB strategies to BarclayHedge CTA Indices over time (T5)

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Our momentum strategies exclude transaction costs and fees (…)

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Nick Baltas (UBS, Imperial College, QMUL)
**CTA Returns Largely Explained by Time-Series Momentum (T6)**

Jan.1994 - Feb.2013:

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Results are robust to other indices (BH-CTA index, Newedge CTA index; paper Appendix).

Given that CTA industry has substantially grown recently, are there any capacity constraints for the time-series momentum strategies?
The evidence that CTAs follow time-series momentum strategies appears overwhelming.

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Given that CTA industry has substantially grown recently, are there any capacity constraints for the time-series momentum strategies?
Rolling Model Fit - further back in time...

- The BarclayHedge Systematic CTA index is available from 1987.
- The FTB strategies are available from 1977.
Capacity Constraints and Trend-following Strategies

We use two different methodologies:

1. CTA Flows and Trend-Following Strategy Performance
   - Performance-flow regressions
     \[ \text{FuF}_j(t) = \frac{\text{AUM}_j(t) - \text{AUM}_j(t-1) \cdot (1 + R_j(t))}{\text{AUM}_j(t-1)} \]
   - Aggregate flow of capital: AUM-weighted average of individual fund flows.
   - Additional hypothesis: inflows into CTAs may not immediately be deployed as margin for future contracts, but instead funds may remain uninvested.
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   - Asset-level thought experiment.
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CTA Flows and Trend-Following Strategy Performance (T7)

- Performance-flow regression (with standardised fund flow variable):

\[
R^K_J(t) = \text{const.} + \phi \sum_{\tau = t - 12}^{t-1} \text{FuF}(\tau) + \sum_{i=1}^{5} \beta_i X_i(t) + \epsilon(t)
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- Relationship is statistically and economically insignificant and also time-varying (...).
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- Performance-flow regression (with standardised fund flow variable):

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## CTA Flows and Trend-Following Strategy Performance (T8)

- Interaction term between flows and sign of changes in aggregate open interest:

\[
R^K_J(t) = \text{const.} + \phi^+ \sum_{\tau=t-12}^{t-1} \text{FuF}(\tau) \cdot I_{\Delta[\text{OI}(t)] > 0} + \phi^- \sum_{\tau=t-12}^{t-1} \text{FuF}(\tau) \cdot I_{\Delta[\text{OI}(t)] < 0} + \sum_{i=1}^{5} \beta_i X_i(t) + \epsilon(t)
\]

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CTA Flows and Trend-Following Strategy Performance (T8)

- Interaction term between flows and sign of changes in aggregate open interest:

\[ R^K_J(t) = \text{const.} + \phi^+ \sum_{\tau=t-12}^{t-1} \text{FuF}(\tau) \cdot I[\Delta[\text{OI}(t)] > 0] + \phi^- \sum_{\tau=t-12}^{t-1} \text{FuF}(\tau) \cdot I[\Delta[\text{OI}(t)] < 0] + \sum_{i=1}^{5} \beta_i X_i(t) + \epsilon(t) \]

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Open Interest & Hypothetical Implementation of Trend-Following Strategies

Asset-level thought experiment:

- **Scenario**: Entire systematic CTA AUM invested in Time-Series Momentum Strategy. 
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1. Strong time-series momentum patterns across different trading frequencies.
2. CTA indices statistically and economically significantly explained by FTB strategies.
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2. Individual CTAs and momentum strategies across frequencies and asset classes.
3. Investigate liquidity-optimised portfolios.
4. Question remains. If not capacity constraints, then what?
   - Monetary/fiscal policy uncertainty particularly high recently.
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   - Simple PCA analysis on the 71 futures contracts shows that the first PC explains:
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APPENDIX
Time-Series Momentum “Smiles” (F3)

Dec.1975 - Feb.2013:
Sharpe Ratios & Correlations of Univariate Momentum Strategies (F4)

Panel A: Monthly Frequency

Panel B: Weekly Frequency

Panel C: Daily Frequency

Nick Baltas (UBS, Imperial College, QMUL)
### Time-Series Momentum Not Explained by Well-Known Benchmarks (T4)


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<td>(c)</td>
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<td>6.32</td>
<td>6.62</td>
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<tr>
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<td>216</td>
<td>216</td>
</tr>
</tbody>
</table>

Nick Baltas (UBS, Imperial College, QMUL)
Correlation between univariate time-series SR’s and illiquidity ranks:
Monthly: -0.01, Weekly: -0.04, Daily: -0.05.

If anything, the negative correlation can be interpreted as more pronounced time-series momentum effects among the most liquid contracts.
Performance-Flow Relationship: Insignificant and Time-Varying (F8)

60-month rolling flow t-statistics:

Panel A: Monthly Frequency

Panel B: Weekly Frequency

Panel C: Daily Frequency

Legend:
- All excl. Commodities
- Commodities
Open Interest & Hypothetical Implementation of Trend-Following Strategies

Must define the “portfolio weights”. Let:

- # contracts per asset -either long or short- for momentum strategy at date \( t \):
  \[
  n_i(t) = \frac{40\%}{\sigma_i(t; 60)}
  \]

- \( S_i(t) \): date \( t \) price of the futures contract of asset \( i \).
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Systematic CTA AUM is *assumed* to be invested in the time-series momentum strategy:

- Dollar amount invested per contract: $w_i(t) \times \text{AUM}(t) \times 10\%$
- # futures positions per asset at date $t$:

$$n_i^{\text{CTA}}(t) = \frac{w_i(t) \times \text{AUM}(t) \times 10\%}{D_i(t) \times m_i} = n_i(t) \times \frac{\text{AUM}(t) \times 10\%}{\sum_{k=1}^{M_t} n_k(t) \times D_k(t) \times m_k}$$

→ Compare $n_i^{\text{CTA}}(t)$ with contemporaneous CFTC-reported open interest $OI_i^{\text{CTA}}(t)$.

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$$\frac{1}{M} \sum_{t=1}^{M} \mathbb{I}\{n_i^{\text{CTA}}(t) > OI_i^{\text{CTA}}(t)\} \text{ for each asset } i,$$

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- # futures positions per asset at date $t$:

$$n_{i\text{CTA}}(t) = \frac{w_i(t) \text{AUM}(t) \times 10\%}{D_i(t) m_i} = n_i(t) \frac{\text{AUM}(t) \times 10\%}{\sum_{k=1}^{M_t} n_k(t) D_k(t) m_k}$$

→ Compare $n_{i\text{CTA}}(t)$ with contemporaneous CFTC-reported open interest $OI_{i\text{CTA}}(t)$.

- Calculate the average number of months that the number of contracts $n_{i\text{CTA}}$ per asset exceed the respective contemporaneous open interest:

$$\frac{1}{M} \sum_{t=1}^{M} \mathbb{1}\{n_{i\text{CTA}}(t) > OI_{i\text{CTA}}(t)\} \text{ for each asset } i,$$

where $M$ is the number of months in the evaluation period.

Open Interest & Hypothetical Implementation of Trend-Following Strategies

Systematic CTA AUM is assumed to be invested in the time-series momentum strategy:

- Dollar amount invested per contract: $w_i(t) \text{AUM}(t) \times 10\%$
- \# futures positions per asset at date $t$:

$$n_i^{\text{CTA}}(t) = \frac{w_i(t) \times \text{AUM}(t) \times 10\%}{D_i(t) \times m_i} = n_i(t) \frac{\text{AUM}(t) \times 10\%}{\sum_{k=1}^{M} n_k(t) \times D_k(t) \times m_k}$$

→ Compare $n_i^{\text{CTA}}(t)$ with contemporaneous CFTC-reported open interest $OI_i^{\text{CTA}}(t)$.

- Calculate the average number of months that the number of contracts $n_i^{\text{CTA}}$ per asset exceed the respective contemporaneous open interest:

$$\frac{1}{M} \sum_{t=1}^{M} \mathbb{1}\{n_i^{\text{CTA}}(t) > OI_i^{\text{CTA}}(t)\} \text{ for each asset } i,$$

where $M$ is the number of months in the evaluation period.