

Momentum Strategies in Futures Markets and Trend-following Funds

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- *“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”. (The Financial Times, November 27, 2011, “Winton’s head is a proud speculator”,)*
- We carry out (i) in-depth study of momentum strategy (**larger** cross-section, **more** frequencies, **longer** sample period) and (ii) analysis of **capacity constraints** in these strategies, which matter for investors
- Momentum phenomenon widespread and CTA's a popular investment in recent years
- We combine research on momentum strategies in futures markets with research on hedge funds/CTAs

Presentation Outline

- Motivation
- Related Literature
- Methodology
- Data
- Empirical Results
- Conclusions

We thank INQUIRE Europe for financial support

Main Findings

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- CTA indices statistically and economically significantly exposed to M, W and D
- No evidence of capacity constraints: negative M,W,D performance - flow relationship, but time-varying and not significant; consistent with liquid futures markets
- Implications for CTA and HF investors.

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 - Jylha and Suominen (2011), Della Corte et al (2011), Koijen and Vrugt (2011), Naik, Ramadorai and Stromqvist (2007)

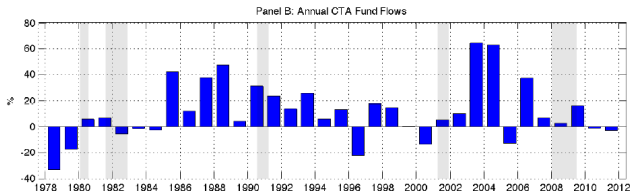
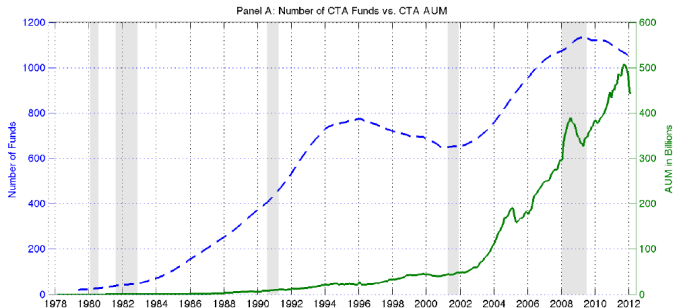
- Futures Data

- Tick data; Dec. 1974-Jan. 2012; futures prices for 71 assets(26 commodities, 23 equity indices, 7 currencies and 15 intermediate-term and long-term bonds)
- Construct returns following MOP (2012): roll so that we trade most liquid contract; Ratio-adjust backwards prices;

- CTA/Hedge fund data:

- BarclayHedge database: see Joenvaara, Kosowski and Tolonen (2012) for comparison of different data bases; 3834 unique CTA funds between June 1959 and January 2012; total AUM end of 2012 of \$444 billion (down from \$507 billion in August 2011);
- CTA index data: BarclayHedge CTA index as well as our AuM-weighted index of CTA universe

CTAs: Number, AuM and Flows (F5)



- Construction of the return series of the (aggregate) **time-series momentum** strategy:

$$R_J^K = \frac{1}{M_t} \sum_{i=1}^{M_t} \text{SIGN}_i(t - J, t) \cdot \frac{40\%}{\sigma_i(t; D)} \cdot R_i(t, t + K), \quad (1)$$

where M_t is the number of available assets at time t , $\sigma_i(t; D)$ denotes an estimate at time t of the realized volatility of the i^{th} asset

- Volatility Estimates:
 - Volatility estimates affect turnover and transaction costs
 - We use Yang and Zhang (2000) volatility estimator:

$$\sigma_{YZ}^2(t; D) = \sigma_{\text{OPEN}}^2(t; D) + k\sigma_{\text{STDEV}}^2(t; D) + (1 - k)\sigma_{\text{RS}}^2(t; D)$$

with 60-day estimates of volatility.

- YZ (2000) most efficient estimator in a pool of range estimators; unbiased volatility estimator that is independent of both the opening jump and the drift of the underlying price process (Shu and Zhang (2006) and Baltas (2011))

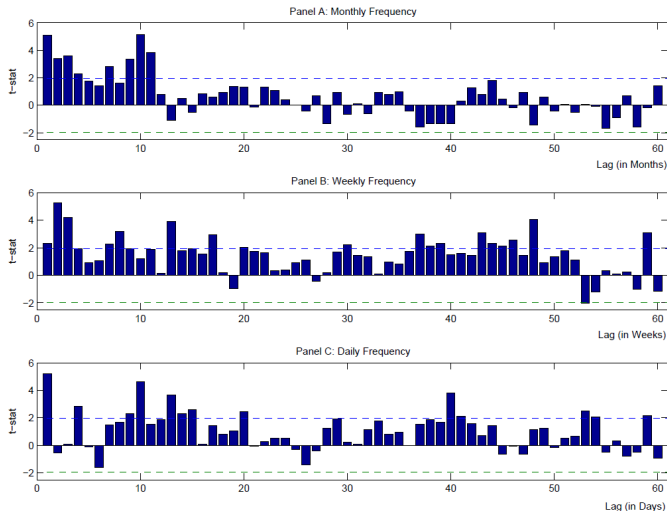
Serial Correlation and Return Predictability

- Assess amount of return predictability that is inherent in lagged returns on the monthly, weekly and daily frequencies by running the following pooled time-series cross-sectional

$$\frac{R(t-1, t)}{\sigma_{YZ}(t-1; 60)} = \alpha + \beta_{\lambda} \frac{R(t-h-1, t-h)}{\sigma_{YZ}(t-h-1; 60)} + \epsilon(t),$$

- So we regress the excess return for an instrument in month t on its return lagged h months, where both returns are scaled by their ex ante volatilities
- The quantity of interest in these regressions is the t-statistic of the coefficient β_{λ} for each lag. Large and significant t-statistics essentially support the hypothesis of time-series return predictability.
- Results show significant t-statistics for monthly frequency for first 12 months (Figure 1, Panel A); clustered around two distinct periods for weekly frequency (Panel B); also two subperiods for daily frequency (Panel C)

Preliminary Evidence of Return Predictability (Figure 1)



Momentum Profitability

- Following evidence of return predictability proceed to construction of time-series momentum strategies for a grid of lookback (J) and investment periods (K)
- Instead of forming a new momentum portfolio every K periods, when the previous portfolio is unwound, we follow overlapping methodology
- MWD:
 - Panel A presents the results for the monthly strategy and $K, J = \{1, 3, 6, 9, 12, 24, 36\}$ months
 - Panel B presents the results for the weekly strategy and $K, J = \{1, 2, 3, 4, 6, 8, 12\}$ weeks
 - Panel C presents the results for the daily strategy and $K, J = \{1, 3, 5, 10, 15, 30, 60\}$ days.
- time-series momentum strategy generates a statistically and economically significant mean return and alpha for all three rebalancing frequencies.

Momentum Profitability - Monthly Frequency (T3A)

Panel A: Monthly Frequency

<i>K</i>	1	2	6	9	12	24	36
<i>J</i>	Annualised Mean (%)						
1	11.85***	9.37***	7.13***	7.08***	7.44***	4.55***	3.23***
3	14.00***	10.59***	8.73***	10.26***	9.37***	6.20***	4.47***
6	13.30***	11.11***	12.12***	11.63***	9.87***	6.45***	4.24***
9	16.56***	16.77***	15.15***	13.33***	11.48***	7.28***	5.03***
12	18.54***	16.27***	13.59***	12.13***	10.51***	6.76***	4.67**
24	11.45***	10.58***	9.14***	8.08***	7.01***	4.38*	3.18
36	8.36***	7.52***	6.58**	5.47**	4.39*	2.92	2.63

	1	3	6	9	12	24	36
	Sharpe ratio						
	0.92	1.04	1.04	1.11	1.27	0.94	0.75
	0.97	0.83	0.83	1.05	1.05	0.84	0.66
	0.89	0.82	0.99	1.00	0.92	0.74	0.51
	1.13	1.23	1.16	1.07	0.98	0.74	0.57
	1.25	1.15	1.01	0.95	0.87	0.65	0.51
	0.78	0.73	0.66	0.61	0.55	0.38	0.30
	0.60	0.55	0.50	0.42	0.35	0.24	0.22

Sharpe Ratios for MWD (T3 A, B and C)

1	3	6	9	12	24	36
Sharpe ratio						
0.92	1.04	1.04	1.11	1.27	0.94	0.75
0.97	0.83	0.83	1.05	1.05	0.84	0.66
0.89	0.82	0.99	1.00	0.92	0.74	0.51
1.13	1.23	1.16	1.07	0.98	0.74	0.57
1.25	1.15	1.01	0.95	0.87	0.65	0.51
0.78	0.73	0.66	0.61	0.55	0.38	0.30
0.60	0.55	0.50	0.42	0.35	0.24	0.22

1	2	3	4	6	8	12
Sharpe ratio						
0.65	0.99	1.15	1.13	1.07	1.24	1.20
0.95	1.02	1.08	1.01	0.98	1.15	1.15
1.20	1.14	1.09	0.99	1.02	1.12	1.18
1.20	1.13	1.04	0.99	1.00	1.07	1.12
1.14	1.06	1.03	0.98	1.02	1.05	1.05
1.25	1.22	1.14	1.08	1.04	1.05	1.04
1.25	1.28	1.21	1.13	1.06	1.03	0.98

1	3	5	10	15	30	60
Sharpe ratio						
1.51	0.69	0.81	0.80	0.99	0.86	0.89
1.22	0.61	0.49	0.74	0.97	0.93	1.01
1.24	0.65	0.46	0.78	0.98	0.98	1.11
1.06	0.73	0.71	0.89	0.95	0.91	1.07
1.21	1.02	0.96	1.02	0.96	0.92	1.08
1.24	1.07	1.02	0.98	0.95	0.93	1.00
1.26	1.23	1.20	1.19	1.13	1.02	0.96

Best Performing Strategies

- Pairs (12, 1), (9, 3) and (1, 12) as the three best monthly strategies
- Weekly: best strategy pair is (8, 1), followed by the pairs (12, 2) and (1, 8)
- We decide to work with the strategies M_{12}^1 , W_8^1 and D_{15}^1 for the remaining of the paper (MWD in short)

Summary Statistics for Best Strategies - Table 4A

Panel A: Performance Statistics

	M_{12}^1	M_9^3	M_{12}^1	W_8^1	W_{12}^2	W_1^8	D_{15}^1	D_{60}^1	D_1^{15}
Ann. Mean Return (%)	18.54	16.77	7.44	15.72	16.61	6.95	18.44	18.08	4.75
Ann. Volatility (%)	14.88	13.66	5.88	12.57	13.00	5.61	15.25	14.34	4.79
Skewness	-0.34	-0.46	-0.30	0.73	0.54	0.97	1.61	0.47	2.54
Kurtosis	4.75	5.35	5.40	4.93	4.51	5.76	10.75	3.60	18.15
CAPM Beta	0.00	0.02	0.01	-0.15	-0.12	-0.06	-0.26	-0.16	-0.09
	(-0.05)	(0.22)	(0.13)	(-2.41)	(-1.82)	(-2.32)	(-3.29)	(-2.25)	(-3.63)
Sharpe ratio	1.25	1.23	1.27	1.26	1.29	1.23	1.21	1.27	0.99
Downside-Risk SR	1.59	1.54	1.63	1.94	1.95	2.04	2.05	1.94	1.79
Sortino Ratio	1.32	1.28	1.30	1.66	1.65	1.81	1.74	1.70	1.64
Maximum Drawdown (%)	22.12	25.10	9.18	12.03	15.63	6.86	15.65	17.68	7.18
MDD Period	2	6	2	16	8	7	16	10	25
Dollar Growth	365.0	213.2	11.8	156.2	207.3	10.0	348.6	319.8	4.8

Summary Statistics for Best Strategies - Table 4B

Panel B: Correlation Matrix

	M_{12}^1	M_9^3	M_1^{12}	W_8^1	W_{12}^2	W_1^8	D_{15}^1	D_{60}^1	D_1^{15}
M_{12}^1	1.00								
M_9^3	0.89	1.00							
M_1^{12}	0.84	0.88	1.00						
W_8^1	0.41	0.38	0.38	1.00					
W_{12}^2	0.52	0.50	0.50	0.80	1.00				
W_1^8	0.43	0.41	0.44	0.84	0.74	1.00			
D_{15}^1	0.22	0.20	0.20	0.52	0.43	0.55	1.00		
D_{60}^1	0.51	0.47	0.48	0.78	0.89	0.72	0.52	1.00	
D_1^{15}	0.33	0.30	0.31	0.52	0.46	0.57	0.84	0.56	1.00

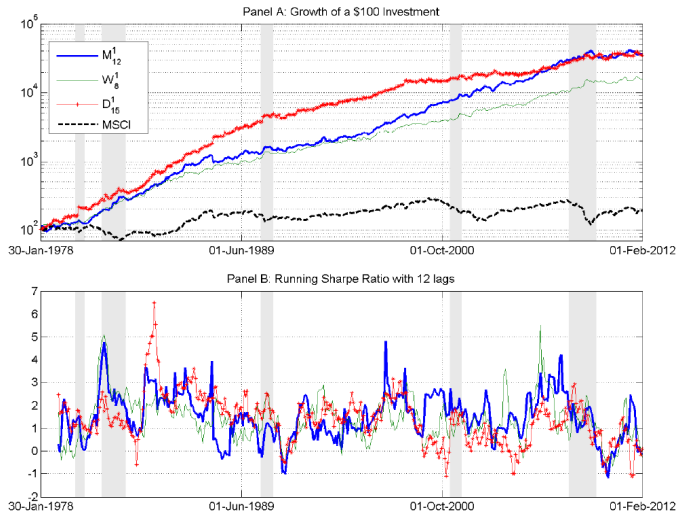
Decomposition of the MWD Strategies T5 (part 1)

	M_{12}^1			W_8^1			D_{15}^1		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
alpha	13.81 (4.77)	17.33 (5.51)	20.26 (5.72)	13.69 (5.36)	15.19 (6.29)	20.05 (6.58)	13.12 (5.21)	12.91 (5.38)	18.67 (7.18)
MSCI	0.05 (0.49)			-0.14 (-1.90)			-0.15 (-1.93)		
S&P500		0.01 (0.07)	0.01 (0.06)		-0.03 (-0.46)	-0.02 (-0.30)		-0.07 (-1.09)	-0.05 (-0.92)
SMB	-0.01 (-0.22)			-0.11 (-1.62)			-0.06 (-0.71)		
SCMLC		0.06 (0.80)	0.06 (0.78)		-0.00 (-0.07)	0.00 (0.05)		0.01 (0.19)	0.02 (0.40)
HML	0.01 (0.18)			-0.04 (-0.67)			-0.02 (-0.19)		
GSCI	0.01 (0.16)			0.01 (0.19)			-0.02 (-0.38)		
BOND	-0.05 (-0.19)			-0.08 (-0.39)			-0.16 (-0.68)		
UMD	0.32 (5.67)			0.09 (1.93)			-0.02 (-0.51)		

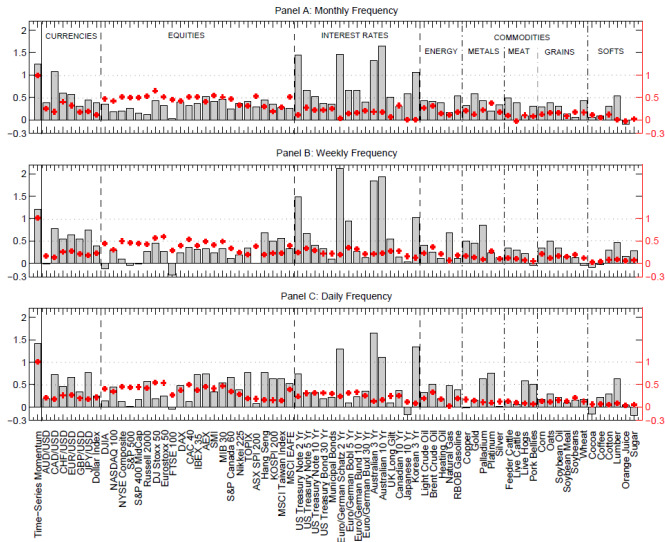
Decomposition of the MWD Strategies T5 (part 2)

	M_{12}^1			W_8^1			D_{15}^1		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
PTF Bonds		-0.05 (-2.39)	-0.05 (-2.27)		0.01 (0.43)	0.00 (0.10)		0.04 (2.20)	0.03 (2.24)
PTF FX		0.00 (0.30)	0.00 (0.26)		0.03 (2.11)	0.02 (1.79)		0.02 (1.20)	0.01 (0.46)
PTF Com		0.06 (2.54)	0.07 (2.72)		0.07 (4.07)	0.07 (4.62)		0.07 (2.80)	0.07 (3.05)
PTF IR			-0.01 (-1.90)			-0.00 (-0.52)			0.01 (0.76)
PTF Stock			0.04 (1.67)			0.08 (3.91)			0.10 (6.19)
TCM 10Y		0.17 (1.16)	0.14 (0.99)		-0.01 (-0.14)	-0.06 (-0.66)		-0.05 (-0.52)	-0.11 (-1.21)
BAA Spread		-0.21 (-1.27)	-0.23 (-1.23)		-0.29 (-1.42)	-0.20 (-1.13)		-0.08 (-0.48)	0.07 (0.63)
adj. R^2 (%)	14.89	6.65	7.56	5.88	19.06	26.43	1.95	15.40	28.87
N	264	204	204	264	204	204	264	204	204

Historical Performance of Momentum Strategies (F2)



Sharpe Ratios and Correlations of Univariate Time-Series Momentum Strategies (F3)



Comparison of MWD to CTA Indices over time (T6A)

Panel A: Yearly Performance

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
M_{12}^1	10.34	15.33	19.41	37.19	28.20	36.65	37.32	44.26	27.11	8.84	10.39	24.18
W_8^1	21.82	-2.45	32.69	31.70	37.52	17.69	43.16	21.64	11.51	37.30	2.36	9.80
D_{15}^1	36.92	17.23	38.02	28.95	20.64	36.41	50.40	48.05	32.01	65.31	21.28	19.46
AUMW CTA Index	58.43	46.24	65.22	8.37	13.40	-7.56	16.22	19.05	-3.80	39.06	0.64	-1.40
BH CTA Index	-	-	47.48	8.09	5.58	13.84	-1.04	16.61	-2.21	49.34	14.54	-6.11
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
M_{12}^1	18.52	-5.69	14.06	21.24	3.49	9.07	24.21	27.48	24.02	34.92	13.19	24.68
W_8^1	37.51	0.36	11.54	19.01	3.04	11.81	9.80	17.71	25.73	7.70	6.26	21.79
D_{15}^1	37.66	3.50	18.07	18.88	11.83	9.11	11.27	27.18	32.83	5.57	-6.25	15.11
AUMW CTA Index	12.22	4.39	-1.25	9.54	-5.93	6.68	9.57	5.30	8.59	-1.70	3.62	4.41
BH CTA Index	12.31	-1.80	-4.29	7.28	-4.40	7.65	3.74	5.38	2.06	-5.63	1.88	-2.91
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011		
M_{12}^1	26.35	15.87	13.22	19.75	38.56	24.12	26.35	-9.37	7.26	-2.33		
W_8^1	14.08	12.88	9.15	20.31	21.90	5.32	49.76	-8.79	14.52	-1.11		
D_{15}^1	8.23	3.17	-4.34	12.42	10.81	19.56	28.76	-12.25	18.50	-3.71		
AUMW CTA Index	12.47	18.58	3.87	2.33	-0.38	6.73	12.13	-4.33	18.75	1.37		
BH CTA Index	10.57	7.60	2.10	-1.23	-1.22	2.85	12.26	-0.15	6.96	-3.10		

Comparison of MWD to CTA Indices over time (T6B)

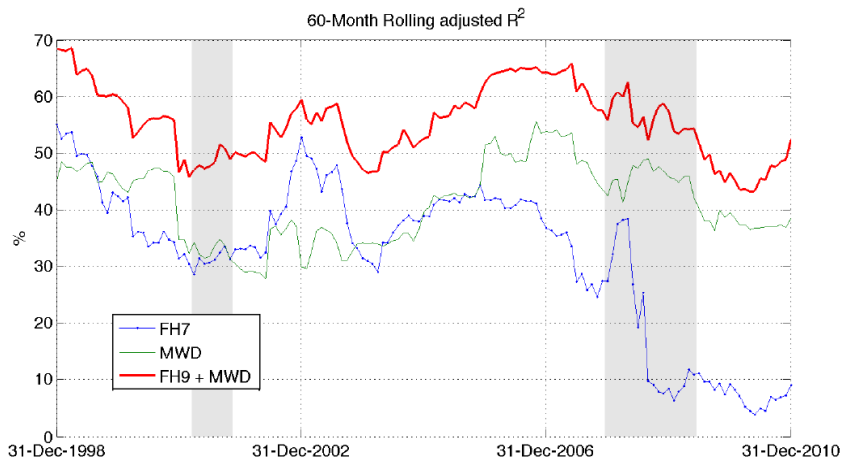
Panel B: Correlation Matrix & Recession/Expansion Performance

	M_{12}^1	W_8^1	D_{15}^1	AUMW Index	BH Index	Return		Volatility		Sharpe ratio	
						REC	EXP	REC	EXP	REC	EXP
M_{12}^1	1.00					18.11**	18.61***	17.81	14.33	1.03	1.30
W_8^1	0.43	1.00				28.07***	13.61***	17.49	11.41	1.62	1.19
D_{15}^1	0.22	0.55	1.00			25.14***	17.29***	23.56	13.29	1.08	1.30
AUMW CTA Index	0.38	0.51	0.42	1.00		13.34*	10.25***	16.63	14.63	0.81	0.70
BH CTA Index	0.31	0.45	0.36	0.90	1.00	12.58*	5.52**	17.73	14.39	0.72	0.38

Return Decomposition of the AUM-Weighted CTA Index (T7)

	(a) FH7	(b) FH9	(c)	(d)	(e)	(f) MWD	(g)	(h)	(i) FH9+ MWD
alpha	5.87 (3.33)	8.88 (4.61)	0.41 (0.20)	0.05 (0.03)	2.83 (1.41)	-2.38 (-1.36)	-3.55 (-2.07)	-0.01 (-0.00)	-1.65 (-0.83)
S&P500	0.00 (0.08)	0.00 (0.02)					-0.00 (-0.09)		0.01 (0.27)
SCMLC	0.02 (0.53)	0.02 (0.50)					0.01 (0.30)		0.01 (0.15)
PTF Bonds	0.03 (2.47)	0.03 (2.85)						0.04 (3.88)	0.03 (3.37)
PTF FX	0.04 (3.86)	0.04 (4.40)						0.03 (4.21)	0.03 (4.19)
PTF Com	0.03 (2.31)	0.04 (2.82)						0.01 (0.64)	0.00 (0.44)
PTF IR		-0.02 (-2.63)						-0.02 (-2.70)	-0.01 (-2.70)
PTF Stock		0.04 (3.04)						0.00 (0.36)	-0.00 (-0.01)
TCM 10Y	0.27 (3.13)	0.23 (2.80)					0.30 (4.19)		0.23 (3.20)
BAA Spread	0.08 (1.08)	0.05 (0.70)					0.15 (1.74)		0.14 (2.20)
M_{12}^1			0.31 (6.26)			0.18 (3.57)	0.16 (3.58)	0.20 (4.99)	0.19 (5.02)
W_8^1				0.44 (8.52)		0.28 (4.95)	0.29 (6.65)	0.22 (4.33)	0.24 (4.87)
D_{15}^1					0.29 (6.22)	0.13 (3.06)	0.13 (3.30)	0.09 (2.15)	0.10 (2.31)
adj. R^2 (%)	23.57	27.24	20.20	31.09	13.98	37.28	42.24	47.33	50.12

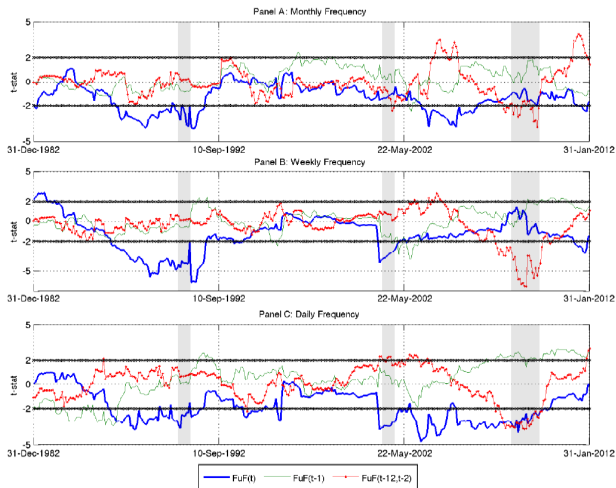
60-Month Rolling adjusted R² (F4)



Time-Series Momentum Profitability and CTA Fund Flows (T8)

	M_{12}^1		W_8^1		D_{15}^1	
FuF(t)	-0.10 (-2.29)	-0.10 (-2.29)	-0.08 (-1.23)	-0.08 (-1.22)	-0.07 (-1.19)	-0.07 (-1.19)
FuF($t-1$)	-0.07 (-1.18)	-0.07 (-1.13)	-0.00 (-0.03)	0.00 (0.05)	-0.00 (-0.06)	0.01 (0.15)
FuF($t-12 \rightarrow t-2$)	0.00 (0.07)	0.01 (0.30)	-0.04 (-0.91)	-0.02 (-0.57)	-0.00 (-0.03)	0.03 (0.85)
log(AUM($t-1$))		-0.05 (-1.10)		-0.08 (-1.73)		-0.19 (-4.96)
MSCI	0.07 (0.58)	0.07 (0.56)	-0.19 (-2.02)	-0.19 (-2.07)	-0.24 (-2.54)	-0.25 (-2.77)
SMB	0.02 (0.43)	0.02 (0.43)	-0.12 (-1.97)	-0.12 (-1.98)	-0.09 (-1.19)	-0.09 (-1.20)
HML	0.05 (0.88)	0.05 (0.85)	-0.04 (-0.70)	-0.04 (-0.85)	-0.02 (-0.26)	-0.03 (-0.50)
GSCI	-0.08 (-0.90)	-0.08 (-0.88)	-0.03 (-0.44)	-0.03 (-0.39)	-0.05 (-0.91)	-0.05 (-0.80)
UMD	0.35 (5.68)	0.35 (5.59)	0.08 (1.50)	0.08 (1.30)	-0.10 (-1.65)	-0.12 (-1.83)

Rolling t-statistics of CTA Fund Flow Variables (F6)



Conclusions

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