

Financialization and Commodity Market Serial Dependence

Zhi Da ¹ Ke Tang ² Yubo Tao ³

¹University of Notre Dame

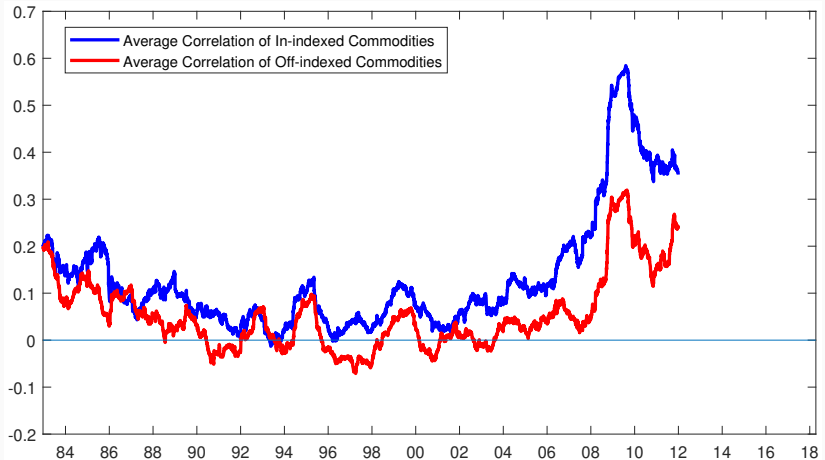
²Tsinghua University

³Singapore Management University

“Since the early 2000s, commodity futures have emerged as a popular asset class for many financial institutions. According to a staff report from the U.S. Commodity Futures Trading Commission (CFTC 2008), the total value of various commodity index-related instruments purchased by institutional investors increased from an estimated **\$15 billion** in 2003 to at least **\$200 billion** in mid-2008...”

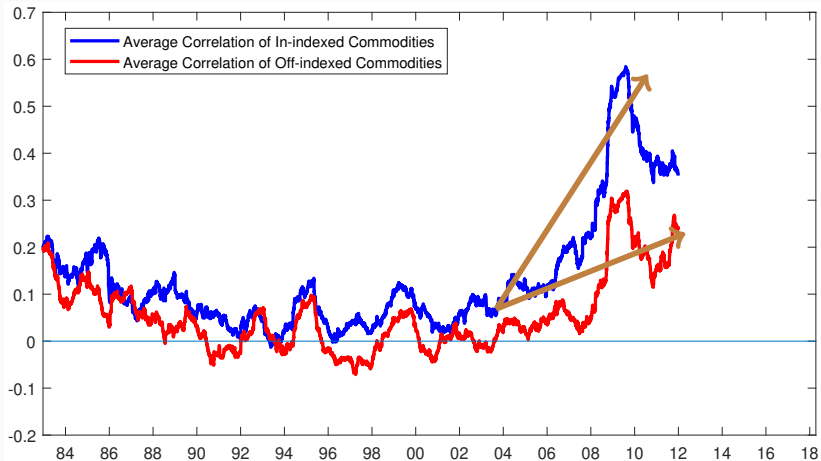
— *Tang and Xiong (FAJ, 2012)*,
[Google Citation: 1150.](#)

Stylized Facts: Average Correlation



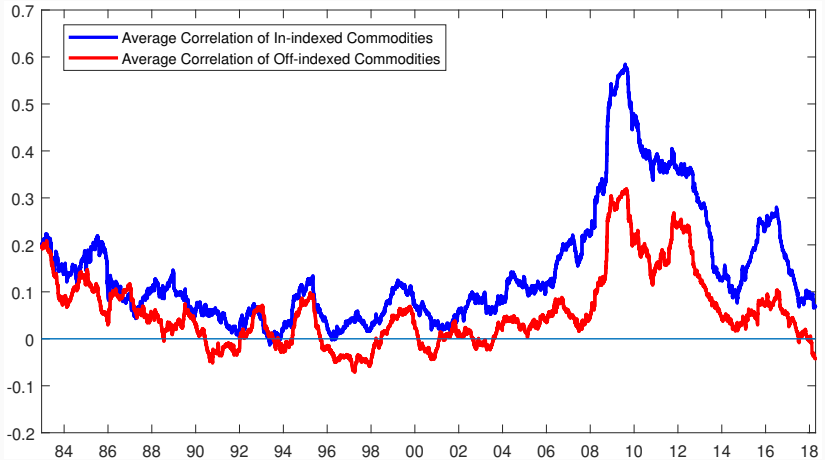
Source: Tang and Xiong (FAJ, 2012)

Stylized Facts: Average Correlation



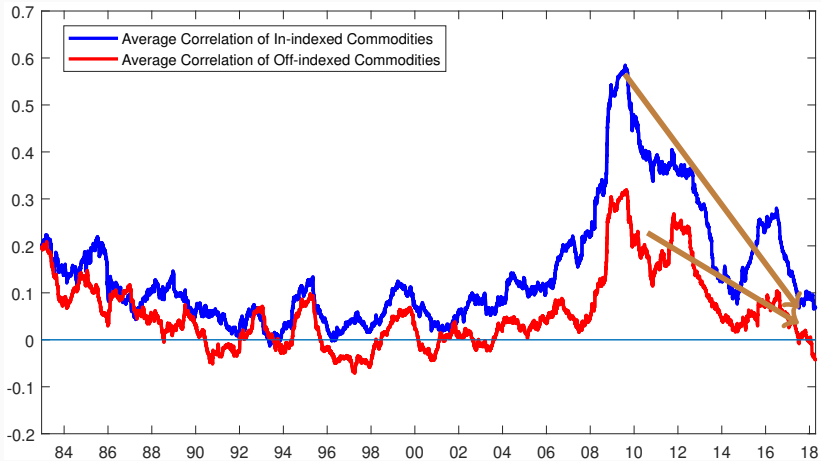
Source: Tang and Xiong (FAJ, 2012)

Stylized Facts: Average Correlation, Updated



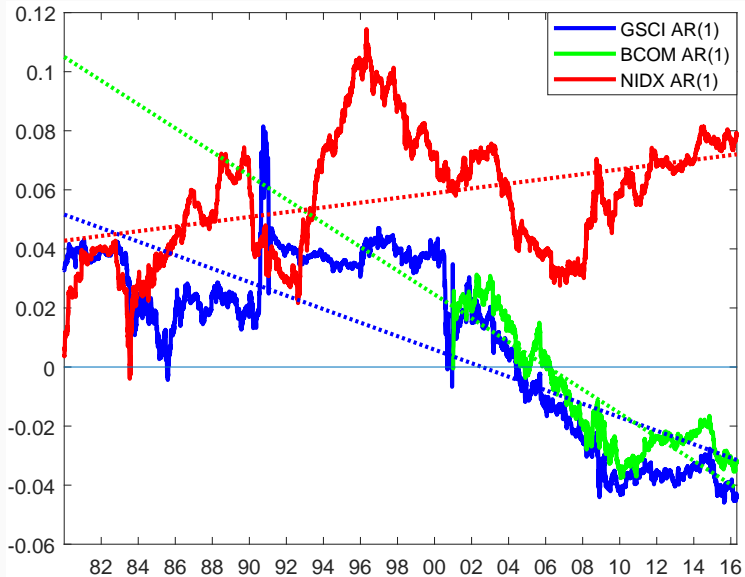
Source: Da, Tang and Tao (2019)

Stylized Facts: Average Correlation, Updated

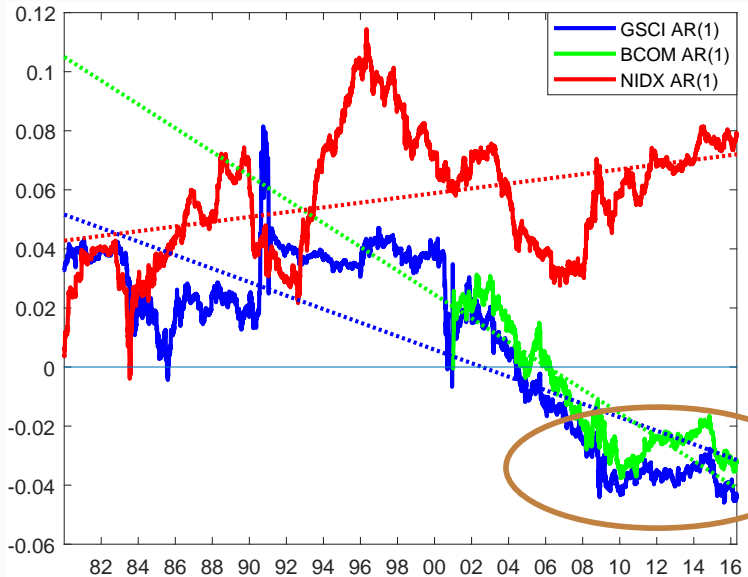


Source: Da, Tang and Tao (2019)

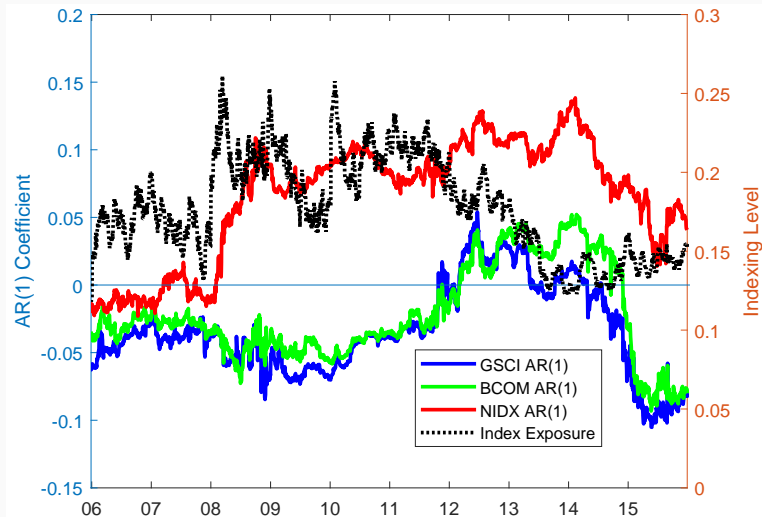
Stylized Facts: Autocorrelation



Stylized Facts: Autocorrelation



Stylized Facts: Autocorrelation and Index Exposure



Summary of Results

- Propagation of non-fundamental shocks among indexed commodities
 - “Connected” index sentiment is **positively** related to **contemporaneous return**, but **negatively** predicts **return tomorrow** for indexed commodities (but not for non-indexed commodities).
- Propagation of sentiment is much stronger during periods when the index is more exposed to institutional trading (or indexing).
- Causality is from commodity index trading to excessive comovement in the commodity index.

- Commodity Financialization:
 - Tang and Xiong (FAJ, 2012) | Tang and Zhu (RFS, 2016) | Basak et al (JF, 2016) | Cheng and Xiong (ARFE, 2014) | Goldstein and Yang (WP, 2017) | Brogaard et al (RFS, 2018), etc.

- Commodity Financialization:
 - Tang and Xiong (FAJ, 2012) | Tang and Zhu (RFS, 2016) | Basak et al (JF, 2016) | Cheng and Xiong (ARFE, 2014) | Goldstein and Yang (WP, 2017) | Brogaard et al (RFS, 2018), etc.
 - *“The trading of index traders can inject both fundamental information and unrelated noise into the futures prices. Therefore, market efficiency can either increase or decrease with financialization.”*
— Goldstein and Yang (WP, 2017)
 - *“Direct tests of price impacts and impacts on correlations should incorporate clear identification strategies.”*
— Cheng and Xiong (ARFE, 2014)

- Side effect of indexing
 - amplification of fundamental shocks (Hong et al., 2014) | non-fundamental price changes (chen et al., 2004) | excessive comovement (Barberis et al., 2005; Greenwood, 2005, 2008; Da and Shive, 2018; Baltussen et al., 2019) | deterioration of the firms information environment (Israeli et al., 2017) | increased non-fundamental volatility in individual stocks (Ben-David et al., 2017) | reduced welfare of retail investors (Bond and Garcia, 2017).
 - Similar effects can exist in the commodity market

Data & Variable Construction

Commodities & Commodities Index

- Commodity Futures Contracts: Pinnacle Corp.
 1. Nearest-to-maturity (front-month) contract: $F_i(t, T_1)$;
 2. Next-to-maturity contract: $F_i(t, T_2)$.

- Returns:

$$r_{it} = \frac{F_i(t, T_1) - F_i(t-1, T_1)}{F_i(t-1, T_1)}$$

- Log Basis:

$$Basis_{it} = \frac{\ln(F_i(t, T_1)) - \ln(F_i(t, T_2))}{T_2 - T_1}$$

- Amihud (2002) Illiquidity:

$$Illiquidity_{it} = \frac{|r_{it}|}{\$ \text{ of Volume}_{it}}$$

- Commodity Indices:
 1. GSCI and BCOM: Yahoo finance;
 2. NIDX: equal-weighted portfolio of off-index commodities.

Name	Exchange	Inception	GSCI	BCOM	CIT	Indexed	Non-indexed
<i>Panel A: Energy</i>							
Crude Oil	NYMEX	1983/03/30	✓	✓		✓	
Heating Oil	NYMEX	1978/11/14	✓	✓		✓	
Natural Gas	NYMEX	1990/04/04	✓	✓		✓	
Gasoline	NYMEX	2005/10/03	✓	✓		✓	
<i>Panel B: Grains</i>							
Soybean Oil	CBOT	1959/07/01		✓	✓		
Corn	CBOT	1959/07/01	✓	✓	✓	✓	
KC Wheat	CBOT	1970/01/05	✓		✓	*	
Minn Wheat	MGEX	1979/01/02					✓
Oat	CBOT	1959/07/01					✓
Rough Rice	CBOT	1986/08/20					✓
Soybean	CBOT	1959/07/01	✓	✓	✓	✓	
Soybean Meal	CBOT	1959/01/07		*	*		✓
Wheat	CBOT	1959/07/01	✓	✓	✓	✓	
<i>Panel C: Livestock</i>							
Feeder Cattle	CME	1971/11/30	✓		✓		
Live Cattle	CME	1964/11/30	✓	✓	✓	✓	
Lean Hogs	CME	1966/02/28	✓	✓	✓	✓	
<i>Panel D: Metals</i>							
Gold	NYMEX	1974/12/31	✓	✓		✓	
Copper	NYMEX	1959/01/07	✓	✓		✓	
Palladium	NYMEX	1977/01/03					✓
Platinum	NYMEX	1968/03/04					✓
Silver	NYMEX	1963/06/12	✓	✓		✓	
<i>Panel E: Softs</i>							
Cocoa	ICE	1959/07/01	✓		✓		
Cotton	ICE	1959/07/01	✓	✓	✓	✓	
Orange Juice	ICE	1967/02/01					✓
Coffee	ICE	1972/08/16	✓	✓	✓	✓	
Lumber	CME	1969/10/01					✓
Sugar	ICE	1961/01/04	✓	✓	✓	✓	

Commodities Index Exposure

- CFTC Commitment of Traders (CoT) Report and Supplemental Commitment of Index Traders (CIT) Report
- Open Interest:

$$\begin{aligned} 2(\text{Open Interest}^{All}) &= \underbrace{(\text{Long} + \text{Short} + 2\text{Spread})}_{\text{Non-commercial}} + \underbrace{(\text{Long} + \text{Short})}_{\text{Commercial}} \\ &\quad + \underbrace{(\text{Long} + \text{Short})}_{\text{Index Trading}} + \underbrace{(\text{Long} + \text{Short})}_{\text{Non-reportable}} \\ \text{Open Interest}^{Idx} &= \underbrace{(\text{Long} + \text{Short})}_{\text{Index Trading}} / 2 \end{aligned}$$

- **Index Exposure:**

$$\text{Indexing}_t = \frac{\sum_i \text{Open Interest}_{iw(t)}^{Idx} \times \text{Contract Size}_i \times \text{Price}_{it}}{\sum_i \text{Open Interest}_{iw(t)}^{All} \times \text{Contract Size}_i \times \text{Price}_{it}}$$

Commodities News Sentiment

- Thomson Reuters News Analytics: 3 tones (positive, negative, neutral)
- Net News Tone: *positive* – *negative*
- Abnormal Net News Tone: Residuals after regressing net news tone on month dummy and first lag.
- **News Sentiment**: orthogonalize tones on fundamentals

$$Abn. Net Tone_t = \alpha + \beta' \begin{bmatrix} r_t \\ r_{t-1} \end{bmatrix} + \theta' \begin{bmatrix} Basis_t \\ Basis_{t-1} \end{bmatrix} + \phi' \begin{bmatrix} Illiquidity_t \\ Illiquidity_{t-1} \end{bmatrix} + \epsilon_t.$$

$\hat{\epsilon}_t \rightarrow$ Non-fundamental Shock/“News Sentiment”.

- **“Connected” Sentiment**:

$$Cnn. Sentiment_{it} = \sum_{S(j) \neq S(i)} W_{jy(t)} Sentiment_{jt}.$$

Main Results

Sentiment Spillover across Commodities: Baseline Result

Variables	Panel A: Contemporaneous		Panel B: Predictive	
	Indexed	Non-indexed	Indexed	Non-indexed
Cnn. Sentiment	0.0605*** (21.47)	0.0507*** (13.21)		
L.Cnn. Sentiment			-0.0052* (-1.86)	-0.0015 (-0.41)
L.Return	-0.0121* (-1.69)	0.0722*** (7.61)	-0.0116 (-1.60)	0.0721*** (7.53)
L.Basis	0.0039 (0.61)	0.0055 (0.40)	0.0037 (0.58)	0.0048 (0.35)
L.Illiquidity	1.58e-05*** (2.66)	1.08e-07 (1.23)	1.56e-05*** (2.59)	1.11e-07 (1.30)
L.ΔOil ImVol	0.0001*** (4.06)	1.06e-05 (0.23)	0.0001*** (4.12)	2.32e-05 (0.49)
Intercept	-0.0006* (-1.64)	0.0004 (0.88)	0.0010** (2.41)	0.0004 (0.87)
Sector Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
# of Obs.	38,165	19,312	38,149	19,305
# of Individuals	16	8	16	8
Overall R-squared	1.50%	1.69%	0.29%	0.71%

Sentiment Spillover across Commodities: Baseline Result

Variables	Panel A: Contemporaneous		Panel B: Predictive	
	Indexed	Non-indexed	Indexed	Non-indexed
Cnn. Sentiment	0.0605*** (21.47)	0.0507*** (13.21)		
L.Cnn. Sentiment			-0.0052* (-1.86)	-0.0015 (-0.41)
L.Return	-0.0121* (-1.69)	0.0722*** (7.61)	-0.0116 (-1.60)	0.0721*** (7.53)
L.Basis	0.0039 (0.61)	0.0055 (0.40)	0.0037 (0.58)	0.0048 (0.35)
L.Illiquidity	1.58e-05*** (2.66)	1.08e-07 (1.23)	1.56e-05*** (2.59)	1.11e-07 (1.30)
L.ΔOil ImVol	0.0001*** (4.06)	1.06e-05 (0.23)	0.0001*** (4.12)	2.32e-05 (0.49)
Intercept	-0.0006* (-1.64)	0.0004 (0.88)	0.0010** (2.41)	0.0004 (0.87)
Sector Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
# of Obs.	38,165	19,312	38,149	19,305
# of Individuals	16	8	16	8
Overall R-squared	1.50%	1.69%	0.29%	0.71%

Sentiment Spillover across Commodities: Baseline Result

Variables	Panel A: Contemporaneous		Panel B: Predictive	
	Indexed	Non-indexed	Indexed	Non-indexed
Cnn. Sentiment	0.0605*** (21.47)	0.0507*** (13.21)		
L.Cnn. Sentiment			-0.0052* (-1.86)	-0.0015 (-0.41)
L.Return	-0.0121* (-1.69)	0.0722*** (7.61)	-0.0116 (-1.60)	0.0721*** (7.53)
L.Basis	0.0039 (0.61)	0.0055 (0.40)	0.0037 (0.58)	0.0048 (0.35)
L.Illiquidity	1.58e-05*** (2.66)	1.08e-07 (1.23)	1.56e-05*** (2.59)	1.11e-07 (1.30)
L.ΔOil ImVol	0.0001*** (4.06)	1.06e-05 (0.23)	0.0001*** (4.12)	2.32e-05 (0.49)
Intercept	-0.0006* (-1.64)	0.0004 (0.88)	0.0010** (2.41)	0.0004 (0.87)
Sector Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
# of Obs.	38,165	19,312	38,149	19,305
# of Individuals	16	8	16	8
Overall R-squared	1.50%	1.69%	0.29%	0.71%

Sentiment Spillover across Commodities: High Index Exposure

Variables	Panel A: Contemporaneous		Panel B: Predictive	
	Indexed	Non-indexed	Indexed	Non-indexed
Cnn. Sentiment	0.0493*** (12.08)	0.0406*** (7.60)		
L. Cnn. Sentiment			-0.0146*** (-3.55)	-0.0046 (-0.86)
L.Return	-0.0343*** (-3.28)	0.0431*** (2.83)	-0.0462*** (-4.19)	0.0434*** (2.96)
L.Basis	0.0017 (0.17)	0.0162 (0.87)	0.0009 (0.09)	0.0170 (0.88)
L.Illiquidity	9.91e-06 (1.57)	-1.02e-07 (-1.52)	7.55e-06 (1.15)	-8.41e-08 (-1.37)
L.ΔOil ImVol	0.0002*** (3.04)	-6.22e-05 (-1.01)	6.50e-05 (1.36)	-8.41e-05 (-1.23)
Intercept	0.0067*** (9.07)	0.0021 (0.82)	0.0066** (2.02)	0.0034 (1.46)
Sector Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
# of Obs.	17,433	8,787	17,460	8,806
# of Individuals	16	8	16	8
Overall R-squared	2.11%	1.69%	1.14%	0.79%

Sentiment Spillover across Commodities: High Index Exposure

Variables	Panel A: Contemporaneous		Panel B: Predictive	
	Indexed	Non-indexed	Indexed	Non-indexed
Cnn. Sentiment	0.0493*** (12.08)	0.0406*** (7.60)		
L. Cnn. Sentiment			-0.0146*** (-3.55)	-0.0046 (-0.86)
L.Return	-0.0343*** (-3.28)	0.0431*** (2.83)	-0.0462*** (-4.19)	0.0434*** (2.96)
L.Basis	0.0017 (0.17)	0.0162 (0.87)	0.0009 (0.09)	0.0170 (0.88)
L.Illiquidity	9.91e-06 (1.57)	-1.02e-07 (-1.52)	7.55e-06 (1.15)	-8.41e-08 (-1.37)
L.ΔOil ImVol	0.0002*** (3.04)	-6.22e-05 (-1.01)	6.50e-05 (1.36)	-8.41e-05 (-1.23)
Intercept	0.0067*** (9.07)	0.0021 (0.82)	0.0066** (2.02)	0.0034 (1.46)
Sector Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
# of Obs.	17,433	8,787	17,460	8,806
# of Individuals	16	8	16	8
Overall R-squared	2.11%	1.69%	1.14%	0.79%

Sentiment Spillover across Commodities: Low Index Exposure

Variables	Panel A: Contemporaneous		Panel B: Predictive	
	Indexed	Non-indexed	Indexed	Non-indexed
Cnn. Sentiment	0.0697*** (16.90)	0.0582*** (10.20)		
L. Cnn. Sentiment			0.0022 (0.54)	0.0008 (0.15)
L.Return	-0.0220** (-2.06)	0.0838*** (5.90)	-0.0091 (-0.84)	0.0805*** (5.69)
L.Basis	0.0093 (1.17)	0.0104 (0.53)	0.0084 (1.02)	0.0085 (0.44)
L.Illiquidity	2.09e-05*** (3.56)	6.23e-07** (2.27)	2.20e-05*** (4.44)	5.29e-07*** (2.67)
L.ΔOil ImVol	0.0001** (2.28)	0.0001* (1.68)	0.0003*** (4.76)	0.0002*** (2.62)
Intercept	-0.0045*** (-7.37)	-0.0007 (-1.11)	-0.0033*** (-5.53)	-0.0006 (-0.95)
Sector Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
# of Obs.	17,387	8,741	17,344	8,715
# of Individuals	16	8	16	8
Overall R-squared	2.64%	2.77%	0.87%	1.33%

Sentiment Spillover across Commodities: Low Index Exposure

Variables	Panel A: Contemporaneous		Panel B: Predictive	
	Indexed	Non-indexed	Indexed	Non-indexed
Cnn. Sentiment	0.0697*** (16.90)	0.0582*** (10.20)		
L. Cnn. Sentiment			0.0022 (0.54)	0.0008 (0.15)
L.Return	-0.0220** (-2.06)	0.0838*** (5.90)	-0.0091 (-0.84)	0.0805*** (5.69)
L.Basis	0.0093 (1.17)	0.0104 (0.53)	0.0084 (1.02)	0.0085 (0.44)
L.Illiquidity	2.09e-05*** (3.56)	6.23e-07** (2.27)	2.20e-05*** (4.44)	5.29e-07*** (2.67)
L.ΔOil ImVol	0.0001** (2.28)	0.0001* (1.68)	0.0003*** (4.76)	0.0002*** (2.62)
Intercept	-0.0045*** (-7.37)	-0.0007 (-1.11)	-0.0033*** (-5.53)	-0.0006 (-0.95)
Sector Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
# of Obs.	17,387	8,741	17,344	8,715
# of Individuals	16	8	16	8
Overall R-squared	2.64%	2.77%	0.87%	1.33%

Return Autocorrelation and Index Exposure: Interaction

Variables	Full Sample		Exclude Financial Crisis	
	Indexed	Non-indexed	Indexed	Non-indexed
L.(Index Exposure × Return)	-4.3122*** (-2.83)	-0.8201 (-0.35)	-5.7340*** (-3.42)	0.2486 (0.10)
L.Abn. Index Exposure	0.1186*** (3.87)	0.0747* (1.74)	0.1162*** (3.75)	0.0547 (1.21)
L.Return	-0.0223*** (-2.83)	0.0703*** (6.80)	-0.0129 (-1.62)	0.0825*** (7.55)
L.Basis	0.0004 (0.05)	0.0001 (0.01)	0.0013 (0.18)	-0.0129 (-0.79)
L.Illiquidity	1.78e-05*** (3.01)	9.43e-08 (1.26)	1.12e-05* (1.87)	7.57e-08 (0.99)
L.ΔOil ImVol	0.0002*** (4.78)	4.78e-05 (0.97)	6.92e-05* (1.86)	-6.89e-06 (-0.12)
Intercept	0.0081*** (15.25)	0.0079*** (2.84)	0.0080** (2.17)	0.0078*** (2.78)
Individual Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
# of Obs.	34,789	17,513	32,089	16,073
# of Individuals	16	8	16	8
Overall R-squared	0.45%	0.85%	0.32%	0.98%

Return Autocorrelation and Index Exposure: Interaction

Variables	Full Sample		Exclude Financial Crisis	
	Indexed	Non-indexed	Indexed	Non-indexed
L.(Index Exposure × Return)	-4.3122*** (-2.83)	-0.8201 (-0.35)	-5.7340*** (-3.42)	0.2486 (0.10)
L.Abn. Index Exposure	0.1186*** (3.87)	0.0747* (1.74)	0.1162*** (3.75)	0.0547 (1.21)
L.Return	-0.0223*** (-2.83)	0.0703*** (6.80)	-0.0129 (-1.62)	0.0825*** (7.55)
L.Basis	0.0004 (0.05)	0.0001 (0.01)	0.0013 (0.18)	-0.0129 (-0.79)
L.Illiquidity	1.78e-05*** (3.01)	9.43e-08 (1.26)	1.12e-05* (1.87)	7.57e-08 (0.99)
L.ΔOil ImVol	0.0002*** (4.78)	4.78e-05 (0.97)	6.92e-05* (1.86)	-6.89e-06 (-0.12)
Intercept	0.0081*** (15.25)	0.0079*** (2.84)	0.0080** (2.17)	0.0078*** (2.78)
Individual Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
# of Obs.	34,789	17,513	32,089	16,073
# of Individuals	16	8	16	8
Overall R-squared	0.45%	0.85%	0.32%	0.98%

Return Autocorrelation and Index Exposure: Interaction

Variables	Full Sample		Exclude Financial Crisis	
	Indexed	Non-indexed	Indexed	Non-indexed
L.(Index Exposure × Return)	-4.3122*** (-2.83)	-0.8201 (-0.35)	-5.7340*** (-3.42)	0.2486 (0.10)
L.Abn. Index Exposure	0.1186*** (3.87)	0.0747* (1.74)	0.1162*** (3.75)	0.0547 (1.21)
L.Return	-0.0223*** (-2.83)	0.0703*** (6.80)	-0.0129 (-1.62)	0.0825*** (7.55)
L.Basis	0.0004 (0.05)	0.0001 (0.01)	0.0013 (0.18)	-0.0129 (-0.79)
L.Illiquidity	1.78e-05*** (3.01)	9.43e-08 (1.26)	1.12e-05* (1.87)	7.57e-08 (0.99)
L.ΔOil ImVol	0.0002*** (4.78)	4.78e-05 (0.97)	6.92e-05* (1.86)	-6.89e-06 (-0.12)
Intercept	0.0081*** (15.25)	0.0079*** (2.84)	0.0080** (2.17)	0.0078*** (2.78)
Individual Fixed Effect	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes
# of Obs.	34,789	17,513	32,089	16,073
# of Individuals	16	8	16	8
Overall R-squared	0.45%	0.85%	0.32%	0.98%

Causal Test

- Idea: a commodity can appear in both GSCI and BCOM indices and its respective weights are pre-determined
 - The autocorrelation of a commodity overweighted in index i should be more affected by index trading in index i

Causal Test

- Idea: a commodity can appear in both GSCI and BCOM indices and its respective weights are pre-determined
 - The autocorrelation of a commodity overweighted in index i should be more affected by index trading in index i

Variables	GSCI OW Portfolio		BCOM OW Portfolio	
	Full Sample	Exclude Crisis	Full Sample	Exclude Crisis
L.Relative ETF Indexing	-8.82e-05* (-1.79)	-0.0001** (-2.01)	-9.80e-05** (-2.44)	-0.0001** (-2.50)
L.Relative Return	0.0012 (1.26)	0.0003 (0.56)	-0.0007 (-1.25)	-0.0004 (-1.08)
L.Relative RVOL	-0.0001 (-1.00)	0.0002** (2.27)	9.21e-06 (0.09)	-0.0002** (-2.35)
L.Relative Volume	-1.15e-06 (-0.38)	-2.42e-06 (-1.10)	-6.35e-08 (0.00)	1.15e-06 (0.82)
L.ΔOil ImVol	-2.50e-06* (-1.68)	-3.42e-07 (-0.36)	1.73e-06* (1.79)	7.73e-08 (0.13)
Intercept	-8.83e-07 (-0.33)	-4.46e-06** (-2.36)	1.98e-06 (1.02)	4.10e-06*** (2.74)
# of Obs.	1,930	1,750	1,930	1,750
Adj. R-squared	1.20%	0.17%	1.01%	0.38%