ARC Commodity Factor Risk Model
Monthly Report March 2023

The Asset Risk Company (ARC) Commodity Model is a cross-sectional commodity factor model. The model contains 50 of the most widely traded commodity products with approximately 1,200 futures in total over all maturities. All futures in the model have exposures to sectors, sub-sectors, and style factors such as basis, momentum, and open interest. The model is estimated daily with 21 years of history. It provides a framework for managing risk and investment decision making.

In this report, you will find:

- Performance of Sectors, Sub-Sectors and Style Factors
- Examples of Style Tilted Portfolios (Low Vol, Value, Momentum, Backwardation)
- Inflation prediction
- Risk Factor Decompositions of Popular Commodity Indexes (BCOM, GSCI)

The ARC Commodity Model is a powerful tool to help many constituencies in the financial industry, trading, and real economy. Some of the applications of the model are very straightforward, but some uses of the model are more nuanced. We recommend this short piece that provides details on both common and novel use cases for a commodity factor model: https://www.assetriskcompany.com/whyfactor.html. You can access our latest research at https://www.assetriskcompany.com/library.html.

Sectors and Factors Performance Report:

Table 1. Sectors and Subsectors Performance* Annualized 5 years

Sectors/Subsectors	March 23	YTD	5-year Return	5-year Volatility*
Agriculture	**-3.8%**	**-5.9%**	**13.4%**	**12.1%**
Grain And Oilseed	-4.1%	-7.0%	14.6%	14.3%
Lumber And Pulp	-12.6%	-21.8%	0.8%	52.9%
Proteins	-2.9%	-2.1%	13.6%	10.4%
Energy	**-0.5%**	**-5.4%**	**1.4%**	**15.9%**
Biofuels	-0.2%	-5.5%	13.5%	22.2%
Coal	-3.5%	-4.8%	26.2%	22.6%
Crude Oil	0.1%	-5.1%	-2.5%	18.8%
Natural Gas	1.8%	-7.3%	1.2%	15.9%
Petrochemicals	-0.6%	-4.1%	-2.1%	19.9%
Refined Products	-3.5%	-6.1%	2.1%	20.9%
Metals	**1.2%**	**-0.5%**	**11.1%**	**15.4%**
Base	-1.9%	-0.1%	11.2%	18.9%
Precious	8.8%	-1.3%	13.3%	18.3%

All sectors and subsectors are negative YTD. Agriculture suffered this month with Grains and OilSeed down 4.1%, and proteins down 2.9%. Energy was mostly flattish. Precious Metals and Gold, in particular, had a strong month (+8.8%). Gold now represents 16% of the BCOM index. As a reminder, ARC sectors and sub-sectors returns are not estimated using a static configuration of commodity weightings. The returns come naturally from a cross-sectional regression of the 1,200 assets in the model and therefore cover the entire term structure. For instance, Natural Gas has more than 120 maturities in the model. The model uses all of that information to derive sector

and subsector returns and one can think of our sectors as risk weighted on the entire curve.

Table 2. Styles Performance *Annualized 5 years

Factor	March 23	2023	5-year Return	5-year Volatility
Basis	-0.6%	-0.4%	-6.7%	5.6%
Open Interest	-1.2%	-1.8%	1.0%	4.2%
Momentum	2.5%	-3.5%	0.1%	6.1%
ST Momentum	-0.5%	-4.4%	-7.6%	6.0%
Trading Activity	0.8%	1.2%	0.0%	2.4%
Volatility	0.1%	-5.7%	2.9%	8.5%
ST Volatility	-0.7%	2.6%	0.3%	8.4%

Our Momentum factor had a very strong month (+2.5%). This is interesting as trend strategies in general did not do well in March. The factor returns here come from large portfolios of what are known as "factor replicating" portfolios. The factor replicating portfolios are not a practical way to trade and consist of positions (both long and short) in most of the instruments in the model's universe. We provide a much more parsimonious factor tilted (long only) portfolios later in this analysis.

Style Tilted Portfolios Performance Report:

The BCOM commodity index is down 0.2% in March while GSCI is down 1.1%. The tilted long momentum portfolio had a strong month (+0.9%). This is consistent with the (pure) Momentum factor's performance (+2.5%). Low Volatility is the best performing style portfolio year to date and its Sharpe ratio is close to 1 over the last 5 years.

Table 3. Factor Tilted Portfolios and BCOM Performance

	Value	Momentum	Low Vol	Backwardation	BCOM
March 2023	-3.8%	0.9%	0.5%	-2.0%	-0.2%
2023	-3.5%	-3.2%	-0.7%	-6.7%	-5.4%
Annualized*	10.6%	9.3%	9.1%	10.4%	5.4%
Volatility*	15.7%	17.4%	9.7%	16.7%	15.9%

*Annualized 5 years

Inflation:

We find that the ARC Commodity Model is a good predictor of breakout moves in the headline number, both in bouts of inflation and deflation. For the upcoming March inflation number <u>we forecast an increase of 0.3% for CPI</u> and <u>year on year inflation decreasing to 5.2%.</u>

Factor Correlations:

Long term correlations between sectors and style factors are also relatively low. The model is able to separate sector allocation risk from style risk providing key insights in the real key drivers of risk and performance of a portfolio.

Table 6. Factor Correlations

Correlations	Agriculture	Energy	Metals	Basis	Open Interest	Momentum	ST Momentum	Trading Activity	Volatility	ST Volatility
Agriculture	1.00	0.40	0.31	0.03	0.02	(0.02)	(0.24)	(0.02)	0.15	0.08
Energy	0.28	1.00	0.32	0.17	0.49	(0.27)	(0.19)	(0.22)	(0.08)	0.29
Metals	0.12	0.23	1.00	(0.13)	0.20	0.03	(0.02)	(0.09)	(0.06)	0.17
Basis	0.19	(0.08)	(0.34)	1.00	(0.19)	(0.21)	0.05	0.26	(0.02)	0.08
Open Interest	(0.08)	0.48	0.21	(0.09)	1.00	(0.30)	(0.11)	(0.70)	(0.29)	0.17
Momentum	0.20	(0.11)	(0.02)	(0.19)	(0.48)	1.00	0.19	0.13	0.39	(0.29)
ST Momentum	(0.46)	(0.60)	(0.09)	0.01	(0.13)	0.10	1.00	0.09	0.04	0.10
Trading Activity	0.22	(0.23)	(0.13)	0.12	(0.63)	0.26	(0.15)	1.00	0.16	(0.09)
Volatility	0.13	(0.22)	(0.27)	0.04	(0.00)	(0.01)	0.18	0.24	1.00	(0.73)
ST Volatility	0.30	0.34	0.27	(0.34)	(0.16)	0.32	(0.25)	(0.01)	(0.31)	1.00

1 yr correlations on the right (above the diagonal), 30 days on left (below the diagonal).

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Commodity Indices Risk Decomposition

Energy is the largest sector in GSCI but the smallest in BCOM. Both indices have high z-scores with respect to Open Interest reflecting the fact that the indices' constituents are weighted more heavily on the front month contract. Both indices exposure to Momentum is negative vs the overall universe of futures in the model.

Table7. Factor Exposures

Factors Exposures	BCOM	GSCI
Agriculture	0.36	0.27
Energy	0.27	0.57
Metals	0.37	0.16
Basis	-0.07	-0.10
Open Interest	2.53	2.21
Momentum	-0.17	-0.18
ST Momentum	-0.25	-0.63
Trading Activity	-0.69	0.40
Volatility	0.20	0.40
ST Volatility	0.14	0.25

Exposures, z-scores for BCOM and GSCI as of 3/31/2023

We use a 6 month half life for this risk decomposition so the model is fairly reactive to market conditions. Despite different sector allocations, both indices have similar risk and exposures to styles. If your portfolio is long/short you want to see if you have systematic exposures or whether idiosyncratic risk predominates. For long only managers, you want to find your exposures versus your benchmark. As shown above in the correlation tables, sector correlations with style factors are relatively small. <u>The model is able to separate risk due to sector allocation and styles risk.</u> All risk is not equal. Systematic risk can display non normal behavior when compared to specific or idiosyncratic risk.

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Both types of risks are driven by fluctuation, but systematic risk is driven by the "crowd" expressing some thematic bet. The systematic risk is related to market risk.

Table 8. Risk Attribution of BCOM and GSCI

Index	BCOM	GSCI
Total Risk	**21.8%**	**21.7%**
Agriculture	1.5%	1.3%
Energy	3.2%	7.8%
Metals	3.4%	1.2%
Basis	0.1%	0.0%
Open Interest	11.4%	8.9%
Momentum	0.3%	0.4%
ST Momentum	0.4%	1.6%
Trading Activity	1.0%	-0.5%
Volatility	-0.3%	-0.2%
ST Volatility	0.3%	0.5%
Specific Risk	4.7%	5.5%

Ex-Ante Annual Volatility Decomposition for BCOM and GSCI as of 3/31//2023

Conclusion:

In this report, we have shown the factor performance driving the commodity markets. Using the ARC Commodity model, style tilted portfolios have shown great performance and seem to be suitable benchmarks for active managers to track. We then conducted an analysis into the risk dynamics of two major commodity indices. The view of commodities as diversifiers is quite accurate. All of this was possible with the ARC model. The model enables the user to look at their book or portfolio and how it fits into their thesis as well as how it fits in the broader economic landscape.

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