ARC Commodity Factor Risk Model
Monthly Report June 2022

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 20 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
- Inflation prediction
- Examples of Style Tilted Portfolios (Low Vol, Value, Momentum, Backwardation)
- Risk Factor Decomposition 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	June 22	YTD Perf	5-year Return	5-year Volatility*
Agriculture	**-6.9%**	**14.1%**	**14.5%**	**11.7%**
Grain And Oilseed	-10.5%	12.2%	16.2%	13.8%
Lumber And Pulp	3.5%	-23.1%	25.4%	50.1%
Proteins	2.6%	21.7%	10.3%	10.2%
Energy	**-5.0%**	**25.3%**	**6.7%**	**14.8%**
Biofuels	-3.2%	10.2%	12.7%	21.7%
Coal	11.5%	103.5%	26.9%	22.0%
Crude Oil	-4.8%	20.0%	4.5%	17.2%
Natural Gas	-6.8%	29.4%	3.0%	13.8%
Petrochemicals	-8.9%	12.6%	5.1%	19.1%
Refined Products	-2.2%	38.9%	10.3%	20.3%
Metals	**-3.6%**	**0.3%**	**11.8%**	**14.8%**
Base	-6.7%	-6.8%	14.1%	18.1%
Precious	0.7%	10.9%	9.6%	17.0%

After a fantastic start of the year, June saw a correction in the commodities market. All Sectors are negative on the month. Crude Oil and Natural Gas are down -4.8% and -6.8% this month, respectively. Noticeably, Coal is up more than 100% this year. The constraints on Natural Gas due to the conflict in Ukraine have invigorated the Coal option. The Grains and OilSeed sector had a large correction this month (-10.5%). 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 and Crude Oil have more than 120 maturities each in the model. The model uses all of that information to derive sector and subsector returns. Year to date, commodities are the only asset class performing well for investors. If inflation is not transitory, it stands to reason that the appetite for commodity exposures should increase.

Table 2. Styles Performance *Annualized 5 years

Factor	June-22	YTD Perf	5-year Return	5-year Volatility
Basis	-4.4%	-6.2%	-6.2%	5.4%
Open Interest	-0.1%	7.0%	0.9%	3.9%
Momentum	-0.2%	6.5%	1.9%	5.2%
ST Momentum	-1.7%	-6.3%	-6.1%	5.9%
Trading Activity	0.1%	-2.4%	0.2%	2.3%
Volatility	1.9%	5.4%	5.7%	7.1%
ST Volatility	-5.1%	0.0%	-1.2%	7.5%

ST (Short Term) Momentum (mean reversal over 30 days) is in line with historical expectations. Finally, Momentum slowed down as well. The volatility factor is up 5.4% so far this year. Remember that the factor returns are estimated through cross-sectional regression. 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 much more parsimonious factor tilted (long only) portfolios later in this analysis.

Inflation:

Another application of a commodity factor model is inflation, forecasting, or attribution. We find that the ARC Commodity Model is a good predictor for breakout moves in the headline number, both in bouts of inflation and deflation. For the upcoming June

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inflation number <u>we forecast a CPI up 0.7%</u> and <u>year on year inflation dropping to 8.2% from 8.5%</u>.

Style Tilted Portfolios Performance Report:

Commodities saw a large correction in June. Year to date BCOM is still up 18.4% and GSCI is up 35.8%. After 5 months of momentum fever, we seemed to be back to historical norms for the styles tilted portfolios. Momentum corrected massively while the other styles that we found to over perform the indices, Value, Low Bol, and Low Basis (backwardation) did much better.

Table 3. Factor Tilted Portfolios and BCOM Performance

Year	Value	Momentum	Low Vol	Backwardation	BCOM
June	-4.8%	-9.6%	-3.1%	-5.0%	-10.8%
YTD	1.0%	38.7%	10.2%	20.7%	18.4%
5-yr Perf	13.7%	11.7%	9.8%	13.2%	8.4%
5-yr Volatility	15.1%	17.1%	9.4%	16.1%	15.8%

Factor Correlations:

Table 4. Factor Correlations

Correlations	Agriculture	Energy	Metals	Basis	Open Interest	Momentum	ST Momentum	Trading Activity	Volatility	ST Volatility
Agriculture	1.00	0.41	0.49	(0.25)	0.15	0.25	0.22	(0.04)	(0.08)	0.31
Energy	0.37	1.00	0.47	0.03	0.47	0.05	0.20	(0.16)	(0.28)	0.53
Metals	0.36	0.33	1.00	(0.25)	0.25	0.20	0.29	(0.05)	(0.05)	0.28
Basis	(0.16)	0.08	(0.23)	1.00	(0.09)	(0.14)	(0.23)	0.06	(0.08)	0.02
Open Interest	0.21	0.81	0.39	(0.06)	1.00	0.04	(0.07)	(0.68)	(0.37)	0.08
Momentum	(0.29)	(0.46)	(0.02)	0.01	(0.46)	1.00	0.25	0.00	0.02	(0.06)
ST Momentum	0.03	(0.06)	0.24	0.13	(0.20)	0.01	1.00	0.15	0.08	0.17
Trading Activity	(0.24)	(0.55)	(0.12)	0.18	(0.79)	0.42	0.19	1.00	0.22	0.03
Volatility	(0.17)	(0.60)	(0.11)	(0.21)	(0.50)	0.44	(0.05)	0.50	1.00	(0.58)
ST Volatility	0.20	0.59	0.18	0.17	0.36	(0.47)	0.29	(0.39)	(0.87)	1.00

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

There is much to note in the factor correlations matrix. First, along the top level sectors note that correlations stay roughly consistent between Agriculture, Energy and Metals.

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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.

Commodity Indices Risk Decomposition

In terms of sector exposures, BCOM is approximately equal weighted. GSCI is overweight in Energy. 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, which is usually the most traded contract.

Table 5. Factor Exposures

Factors	BCOM	GSCI
Agriculture	0.32	0.22
Energy	0.40	0.66
Metals	0.28	0.12
Basis	1.05	1.00
Open Interest	2.47	2.05
Momentum	0.30	0.52
ST Momentum	0.40	0.71
Trading Activity	-0.54	-0.27
Volatility	0.57	0.60
ST Volatility	0.52	0.60

Exposures, z-scores for BCOM and GSCI as of 6/30/2022

Table 6. Risk Attribution of BCOM and GSCI

Index	BCOM	GSCI
Total Risk	23.8%	24.7%
Agriculture	1.9%	1.2%
Energy	5.3%	10.8%
Metals	3.1%	1.1%
Basis	1.1%	1.1%
Open Interest	10.8%	8.5%
Momentum	0.0%	0.2%
ST Momentum	0.4%	0.0%
Trading Activity	-0.2%	0.2%
Volatility	-0.8%	-1.0%
ST Volatility	1.4%	1.5%
Specific Risk	6.0%	7.2%

Ex-Ante Annual Volatility Decomposition for BCOM and GSCI as of 6/30/2022

The model allows users to track exposures to Style Factors at the contract level. As expected Energy is the largest contributor for GSCI. This month on the styles side the risk contributions are similar for both indices. Open Interest remains a large contributor for both indices. Note that styles' risk contribution to the total risk is larger than sectors' contributions, for both BCOM and GSCI. As shown above in the correlation tables, sector correlations with style factors are relatively small. The model is able to separate risk due to sector allocation and styles risk. All risk is not equal. Systematic risk can display non normal behavior when compared to specific or idiosyncratic risk. 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.

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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.