ARC Commodity Factor Risk Model
Monthly Report November 2021

The Asset Risk Company (ARC) Commodity model is a cross-sectional commodity factor model. The model contains 50 of the most 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, open interest. The model is estimated daily with 20 years of history. It provides a framework for managing risk and investment decisions.

In this report, you will find:

- Performance of Sectors, Sub-Sectors and Style Factors
- Inflation prediction
- Examples of Styles 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, 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

Factor	Nov 2021	YTD Perf	Historical Returns*	Volatility*
Agriculture	**-1.1%**	**25.6%**	**9.7%**	**9.7%**
Grain And Oilseed	-1.2%	33.9%	12.8%	11.9%
Lumber And Pulp	28.8%	27.5%	26.5%	46.3%
Proteins	0.6%	13.2%	6.0%	9.5%
Softs	-5.7%	14.5%	3.6%	11.2%
Energy	**-4.7%**	**35.7%**	**-0.6%**	**13.6%**
Biofuels	5.8%	66.2%	9.7%	21.4%
Coal	2.7%	50.2%	12.4%	17.2%
Crude Oil	-4.5%	31.0%	-2.0%	16.2%
Natural Gas	-2.9%	28.6%	-3.2%	10.8%
Petrochemicals	-12.2%	36.6%	-1.2%	18.8%
Refined Products	-7.2%	28.1%	-2.0%	19.0%
Metals	**-4.0%**	**10.3%**	**13.4%**	**15.0%**
Base	-2.8%	36.0%	16.7%	17.7%
Precious	-5.7%	-17.4%	9.6%	17.1%

* Annualized 2017-2021

As a reminder, ARC sectors and sub-sectors returns are not estimated using a static configuration of commodity weightings. The returns come naturally from the cross-sectional regression of the 1,200 assets in the model and therefore cover the

entire term structure. For instance NG and CL have more than 120 maturities each in the model.

All 3 sectors posted a negative month. On the Energy front: Crude Oil and Refined Products subsector factors (across all maturities) are down respectively -4.5% and -7.2%. Oil in particular, was very volatile on the last day of the month after the news of a new COVID-19 strain. All subsectors in Agriculture are down this month except Lumber and Pulp that posted an increase of 28.8%.The Lumber & Pulp ARC subsector volatility measured over the last 12 months is 70%. One could argue that this sector is the poster child of the incertitude of the supply chain woes. Metals are down this month but base metals are year to date positive. Precious Metals are still down year to date by 17.4%.

With all commodities sectors down in November, one could be excused for thinking that inflation would slow down. We will show in the section below that we do still expect an increase in inflation.

Table 2. Styles Performance

Factor	Oct-21	YTD	Historical Returns*	Volatility*
Basis	**-2.1%**	**-7.0%**	**-5.6%**	**5.3%**
Open Interest	**-2.5%**	**1.5%**	**-0.7%**	**3.4%**
Momentum	**-3.0%**	**1.8%**	**0.7%**	**4.8%**
ST Momentum	**-2.9%**	**-7.2%**	**-5.9%**	**5.2%**
Trading Activity	**2.1%**	**3.5%**	**0.6%**	**1.9%**
Volatility	**-2.9%**	**9.7%**	**4.9%**	**6.2%**
ST Volatility	**2.3%**	**-6.3%**	**-2.9%**	**6.1%**

* Annualized 2017-2021

All style factors are down significantly this month except Short Term Volatility and Trading Activity. This is expected in such a choppy market that bounced back and forth between the gloom and doom or the promise of a return to pre-COVID days.

Inflation:

Another application of a commodity factor model is inflation forecasting or attribution. With inflation at 6.2% in October, the highest in 30 years, expectations are high for next month's print. Commodities contribute a large part to the CPI. We find that the ARC Model is a good predictor for breakout moves in the headline number, both in bouts of inflation and deflation. Out of sample R-Square over 20 years is above 80% for our estimated inflation vs realized.

For November, we expect a contribution coming from commodities to be +0.5%. This will move inflation above 6.5%. Last month's estimated commodity contribution was 0.5% versus a print of 0.9% (expressed as a month to month log difference). Despite commodity sectors and subsectors' negative performance in November we still see a potential uptick in inflation because CPI is driven by lags of the commodities factor returns.

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Styles Tilted Portfolios Performance Report:

Historical data going back 20 years confirms that style tilted factors out perform significantly some widely followed commodity indices. We track these style tilted portfolios on a monthly basis. The Low Vol portfolio, for example, is composed of commodities whose exposures favor low volatility. All commodity futures selected have large open interest. The other three portfolios are similarly constructed each favoring its respective factor. The portfolios are long only.

Table 3. Factor Tilted Portfolios and BCOM Performance

Returns	Value	Momentum	Low Vol	Backwardation	BCOM
YTD	28.2%	19.9%	23.0%	26.0%	22.8%
Nov. 2021	-3.0%	-11.2%	-2.6%	-9.0%	-7.3%
Annualized*	12.9%	4.2%	6.1%	7.0%	3.0%
Volatility*	15.0%	14.5%	9.1%	15.6%	15.2%

*2017/2021

Graph 2: Cumulative performance Post Covid 2021 for styles tilted portfolio vs BCOM

Overall this was a tough month representing a serious correction for commodities markets. BCOM was down 7.3%. Notice that the Low Vol tilted portfolio outperformed the index by 5% with a -2.6% return. We strongly believe that Low Vol is a key premia factor for commodities, as in the equity world, but clearly ignored or not considered in the commodity world. The other silver lining was the Value portfolio (defined as low momentum commodities) which performed well during the volatile month. As expected the momentum tilted portfolios massively underperformed this month.

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Factor Correlations:

Table 4. Factor Correlations

Correlations	Agriculture	Energy	Metals	Basis	Open Interest	Momentum	ST Momentum	Trading Activity	Volatility	ST Volatility
Agriculture	1.00	0.34	0.38	(0.29)	0.20	0.23	0.17	(0.02)	0.02	0.19
Energy	0.30	1.00	0.28	0.09	0.49	0.23	(0.05)	(0.26)	(0.21)	0.29
Metals	0.15	0.07	1.00	(0.07)	0.22	0.25	0.14	(0.08)	0.01	(0.06)
Basis	(0.18)	0.52	0.07	1.00	0.06	0.00	(0.14)	(0.09)	(0.30)	0.04
Open Interest	0.17	0.57	(0.03)	0.58	1.00	0.36	0.07	(0.58)	(0.39)	(0.12)
Momentum	0.06	(0.07)	0.16	0.05	0.05	1.00	0.13	(0.15)	(0.28)	(0.22)
ST Momentum	0.04	(0.39)	0.54	(0.07)	(0.05)	0.32	1.00	(0.15)	(0.08)	(0.00)
Trading Activity	(0.05)	(0.32)	0.05	(0.33)	(0.72)	0.20	(0.06)	1.00	0.18	0.04
Volatility	(0.16)	(0.48)	0.30	(0.41)	(0.39)	(0.05)	0.37	0.13	1.00	(0.31)
ST Volatility	0.40	0.51	(0.10)	0.13	0.14	(0.20)	(0.35)	(0.24)	(0.61)	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. 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, though the Energy allocation is increasing. As expected, 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 in most cases is the most traded contract. 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.

Table 5. Factor Exposures

Factors	BCOM	GSCI
Agriculture	0.35	0.26
Energy	0.35	0.55
Metals	0.30	0.19
Basis	0.93	0.90
Open Interest	2.39	2.53
Momentum	0.12	0.24
ST Momentum	-0.32	-0.21
Trading Activity	1.11	1.96
Volatility	0.21	0.20
ST Volatility	0.19	0.06

Exposures, z-scores for BCOM and GSCI as of 11/30/2021

The model allows users to track exposures to Styles factors at the contract level. Key contributors to Momentum are driven by energy futures in both BCOM and GSCI.

We see an uptick in Ex-Ante Volatility. Open Interest is the largest contributing factor for both indices followed by Energy. Note that sectors' risk represents around 50% of the total risk for BCOM and GSCI, the rest accrues from Style factors and idiosyncratic 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.

Table 6. Risk Attribution of BCOM and GSCI

Total Risk	**19.8%**	**20.5%**
Agriculture	1.5%	0.9%
Energy	**4.0%**	**6.8%**
Metals	2.5%	1.2%
Basis	1.5%	1.5%
Open Interest	**8.6%**	**8.4%**
Momentum	0.0%	0.0%
ST Momentum	0.1%	0.8%
Trading Activity	0.6%	-0.6%
Volatility	-0.8%	-0.9%
ST Volatility	1.0%	1.8%
Specific Risk	**5.2%**	**4.3%**

Ex-Ante Annual Volatility Decomposition for BCOM and GSCI as of11/30/2021

Conclusion:

In this report, we have shown the factor performance driving the commodity markets. Using the ARC model, Styles 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.