ARC Commodity Factor Risk Model
Monthly Report May 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
- The puzzle of Short-Term Momentum consistent performance
- Examples of Factor Tilted Portfolios (Low Vol, Value, Momentum)
- Low Vol as a new paradigm for commodity portfolios
- Popular Commodity Index (BCOM, GSCI) Risk Factor Decomposition

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.

ARC
Asset Risk Company

Sectors and Factors Performance Report:

Table 1. Sector and Subsector Performance

Factor	May 2021 Perf	YTD Perf	Historical Returns*	Volatility*
Agriculture	**0.7%**	**19.8%**	**9.6%**	**10.1%**
Grain And Oilseed	0.5%	25.8%	12.8%	12.5%
Lumber And Pulp	-14.2%	44.5%	33.7%	43.2%
Proteins	-0.2%	10.5%	6.1%	9.7%
Softs	4.4%	9.3%	3.0%	10.6%
Energy	**3.6%**	**20.2%**	**-3.4%**	**13.5%**
Biofuels	6.0%	59.2%	9.8%	22.1%
Coal	7.7%	22.0%	8.7%	15.1%
Crude Oil	2.8%	20.8%	-4.0%	16.4%
Natural Gas	-0.1%	4.4%	-8.0%	9.7%
Petrochemicals	6.3%	20.4%	-4.1%	17.4%
Refined Products	4.6%	25.8%	-2.6%	19.5%
Metals	**5.3%**	**20.3%**	**17.3%**	**15.2%**
Base	5.1%	37.7%	19.1%	18.2%
Precious	5.4%	-0.6%	15.5%	17.2%

* Annualized 2017-2021

Energy and Base Metals posted a solid month, favored by the renewed economic activity. Precious Metals came back strong this month, mostly due to the talk of inflation.

Lumber and Pulp's meteoric rise has stopped, at least for this month. The commodity super cycle looks intact for now.

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.

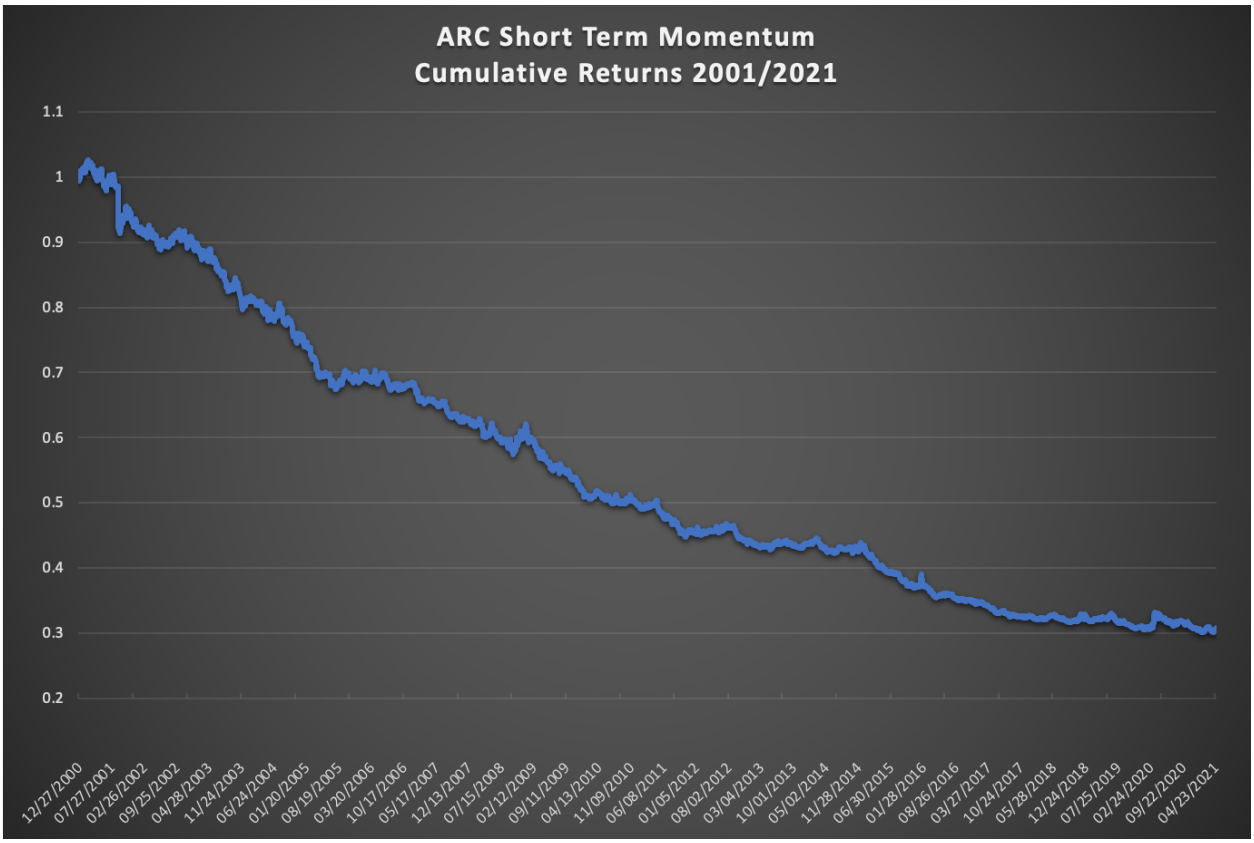
Table 2. Style Performance

Factor	May-21	YTD	Historical Returns*	Volatility*
Basis	**0.2%**	**-3.3%**	**-5.4%**	**5.5%**
Open Interest	**-0.2%**	**0.7%**	**-0.9%**	**3.4%**
Momentum	**1.2%**	**2.1%**	**0.8%**	**4.7%**
ST Momentum	**-1.3%**	**-6.4%**	**-6.4%**	**4.9%**
Trading Activity	**0.7%**	**1.5%**	**0.2%**	**1.9%**
Volatility	**0.1%**	**10.8%**	**5.7%**	**6.1%**
ST Volatility	**0.5%**	**-4.8%**	**-2.9%**	**5.7%**

* Annualized 2017-2021

On the style side, Momentum had a strong month. Short Term Momentum's tumble continues unabated. This has been one of the more puzzling factors. Over the 4 year period 2017-2021, a short position in the factor would have delivered a Sharpe ratio of 1.3. This is consistent with a recent research we completed on 20 years of daily commodity and factor returns. Figure 1 illustrates the performance of the short term momentum factor. A short position in the factor delivers a Sharpe of 1 over 20 years. Alternatively, if you are a manager who loads up on short term momentum strategies, you are hurting your returns.

Figure 1. Short Term Momentum's performance

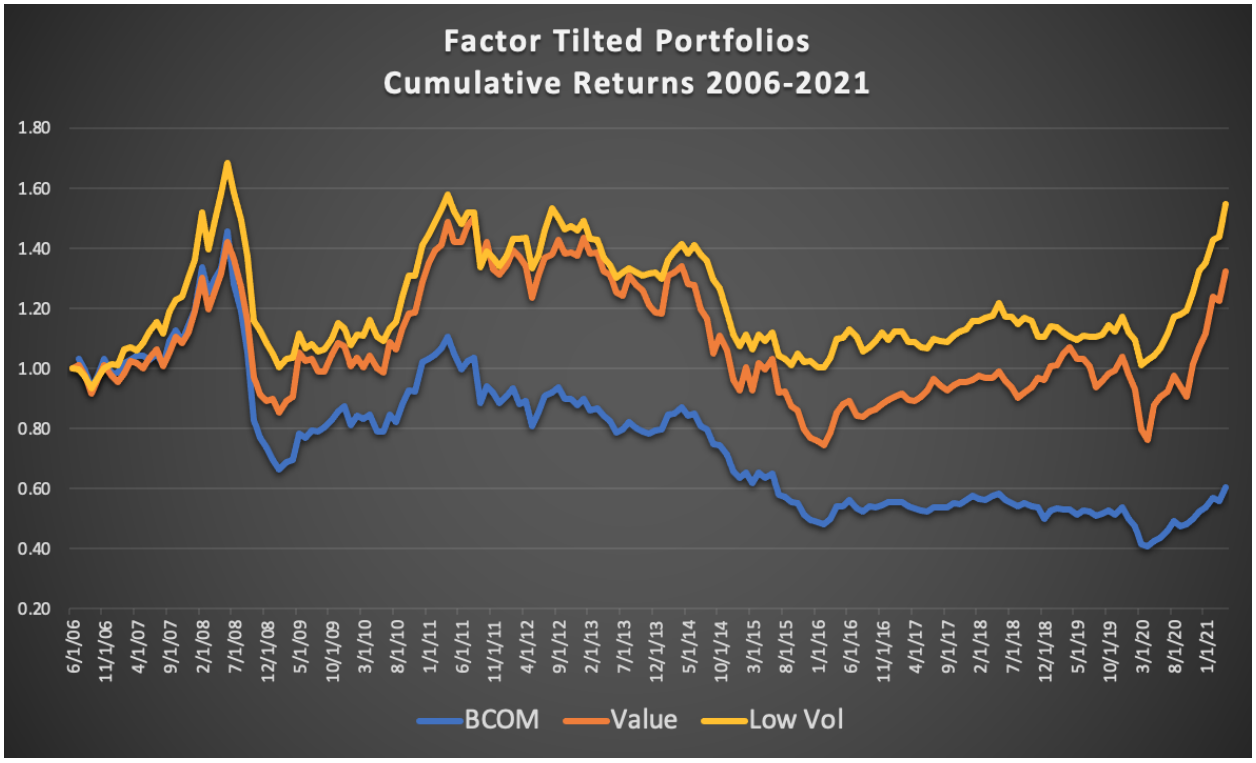


Factor Tilted Portfolios Performance Report:

In order to illustrate a real world application of the model, ARC calculates three factor tilted portfolios. They are the Low Vol, Momentum and Value portfolios. The Low Vol is composed of commodities whose exposures favor low volatility. All commodity futures selected have large open interest. The other two portfolios are similarly constructed. In previous monthly reports, we have detailed the outperformance of the ARC Value and Low Vol tilted portfolios to the index. Some of the financial analysts have suggested this

outperformance could be driven by time period bias of some sort. We endeavored to see how these portfolios would hold up over a longer period of time. You can see below the data from 2006 (where BCOM data is available).

Figure 2. Some Factor Tilted Portfolio vs BCOM



Both ARC portfolios soundly trounce the BCOM Index over the period 2006-2021. The Low Vol tilted portfolio is actually the best performing of the factor tilted portfolios. Low Vol beta portfolios and exchange traded funds (ETFs) are popular in the equity space. They are not very prevalent in commodities, perhaps because commodities tend to be perceived as quite volatile. It is very interesting to see that Low Vol phenomenon extends to this asset class and provides superior return than traditional commodity indices. The late Professor Robert Haugen is surely smiling at this result.

Table 3. Factor Replication Portfolios and BCOM Performance

Returns	Value	Momentum	Low Vol	IPath BB Index
2021	21.2%	17.9%	17.0%	18.9%
May 2021	1.0%	2.5%	1.3%	2.7%
Annualized*	11.5%	3.5%	5.2%	2.5%
Volatility*	17.9%	15.0%	9.8%	14.3%

*2017/2021

Value's performance is quite strong as well. On a risk adjusted basis, all of the ARC Factor Replicating portfolios dominate the industry benchmark. There are better ways to build commodity portfolios-the ARC Commodity Model is suggesting the way!

Factor Correlations:

Table 4. Sector and Subsector Performance

Correlations	Agriculture	Energy	Metals	Basis	Open Interest	Momentum	ST Momentum	Trading Activity	Volatility	ST Volatility
Agriculture	1.00	0.38	0.26	(0.10)	0.12	(0.11)	0.08	0.03	0.31	0.10
Energy	0.16	1.00	0.24	(0.18)	0.46	0.06	0.01	(0.13)	0.29	(0.10)
Metals	0.58	0.28	1.00	(0.11)	0.11	0.00	0.03	0.00	0.04	(0.03)
Basis	(0.14)	(0.46)	0.02	1.00	(0.08)	(0.12)	(0.19)	(0.05)	(0.11)	(0.15)
Open Interest	0.03	0.60	0.18	(0.46)	1.00	0.07	0.03	(0.46)	(0.07)	(0.34)
Momentum	(0.20)	0.39	(0.07)	(0.28)	0.69	1.00	0.14	(0.01)	(0.17)	(0.22)
ST Momentum	0.19	0.31	0.20	(0.24)	0.54	0.37	1.00	(0.15)	(0.30)	0.14
Trading Activity	0.41	(0.56)	(0.00)	0.28	(0.75)	(0.65)	(0.34)	1.00	0.03	0.21
Volatility	(0.15)	(0.39)	(0.12)	0.11	(0.68)	(0.65)	(0.38)	0.43	1.00	(0.35)
ST Volatility	0.27	0.14	(0.00)	0.11	(0.38)	(0.35)	(0.49)	0.41	(0.07)	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

Next, we turn to the exposure and ex-ante annual volatility of the two indices BCOM and GSCI as of 5/31/2021. In terms of sector exposures, BCOM is approximately equal weighted while, 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 and, which in most cases is the most traded contract. It is worth noting that despite very different sector allocations the current risk estimates for both indices is similar, around 16/17% annualized. Also the proportion of risk coming from sectors vs styles is around 50% for both. 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

Index	BB COM	GSCI
Agriculture	0.36	0.28
Energy	0.32	0.54
Metals	0.32	0.18
Basis	0.79	0.79
Open Interest	2.62	2.70
Momentum	0.60	0.66
ST Momentum	0.28	0.17
Trading Activity	-0.36	-0.69
Volatility	0.52	0.61
ST Volatility	0.27	0.35

Exposures, z-scores for BCOM and GSCI as of 5/31/2021

All risk is not equal. Systematic risk can display non normal behavior when compared to specific or idiosyncratic risk. It is not different from the medical concept of bad cholesterol and good cholesterol. Both are cholesterols but one is believed to increase cardiac risk and the other ameliorates it. Similarly, 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. A factor model is key as it divines not only the risk numbers but their nature. There are managers whose finger is on the pulse of the market. These people should have systematic components (and hopefully be successful). Most managers, however, avoid the market risk and base their strategies around relative risk/performance. The risk should then be driven primarily by idiosyncratic risk, with no discernable pattern to the factor exposure.

Table 6. Risk Attribution of BCOM and GSCI

Index	BCOM	GSCI
Total Risk	**16.2%**	**17.1%**
Agriculture	1.8%	1.3%
Energy	2.8%	5.1%
Metals	2.6%	1.1%
Basis	-0.3%	-0.3%
Open Interest	8.2%	8.6%
Momentum	0.4%	0.4%
ST Momentum	0.2%	0.1%
Trading Activity	0.3%	0.5%
Volatility	0.2%	0.4%
ST Volatility	-0.5%	-0.5%
Specific Risk	3.7%	3.6%

Ex-Ante Annual Volatility Decomposition for BCOM and GSCI as of 5/31/2021

Conclusion:

In this report, we have shown the factor performance driving the commodity markets. The strong performance of the commodity markets this month was mostly uniform. Using the ARC model, we have built factor tilted portfolios that 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.