ARC Commodity Factor Risk Model
Monthly Report July 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
- CPI and Inflation estimates for July and August
- Backwardation and Contango Tilted Portfolios Performance over 20 years
- Examples of Factor Tilted Portfolios (Low Vol, Value, Momentum)
- Risk Factor Decomposition of some 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.

ARC
Asset Risk Company

Sectors and Factors Performance Report:

Table 1. Sectors and Subsectors Performance

Factor	July 2021	YTD Perf	Historical Returns*	Volatility*
Agriculture	**-0.2%**	**20.8%**	**9.5%**	**9.9%**
Grain And Oilseed	-0.4%	26.4%	12.4%	12.3%
Lumber And Pulp	-19.3%	-9.5%	19.4%	45.2%
Proteins	0.7%	14.4%	6.7%	9.6%
Softs	2.4%	15.7%	4.1%	10.5%
Energy	**1.7%**	**29.2%**	**-1.7%**	**13.5%**
Biofuels	-6.3%	55.2%	8.8%	22.0%
Coal	7.1%	34.6%	10.7%	15.2%
Crude Oil	0.6%	26.5%	-2.9%	16.2%
Natural Gas	5.3%	17.8%	-5.3%	10.6%
Petrochemicals	1.5%	35.3%	-1.4%	17.8%
Refined Products	0.8%	30.8%	-1.7%	19.2%
Metals	**2.9%**	**20.3%**	**16.6%**	**15.1%**
Base	7.1%	45.7%	19.8%	18.1%
Precious	-2.3%	-7.6%	13.1%	17.2%

* Annualized 2017-2021

YTD all 3 sectors are up double digits, but July saw a slowdown in the commodity market performance. Notably Lumber & Pulp is now in negative territory (-9.5%) after an outstanding 2020. Could it be a precursor of a slow down of activity in the real estate market or a reflection of end of production issues due to the pandemic? In Energy, both

Coal and Natural Gas had a strong month (+7.1% and +5.3%, respectively). Base Metals are now up 45% YTD and 7% in July while precious metals are still negative for the year (-7.6%). 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. Styles Performance

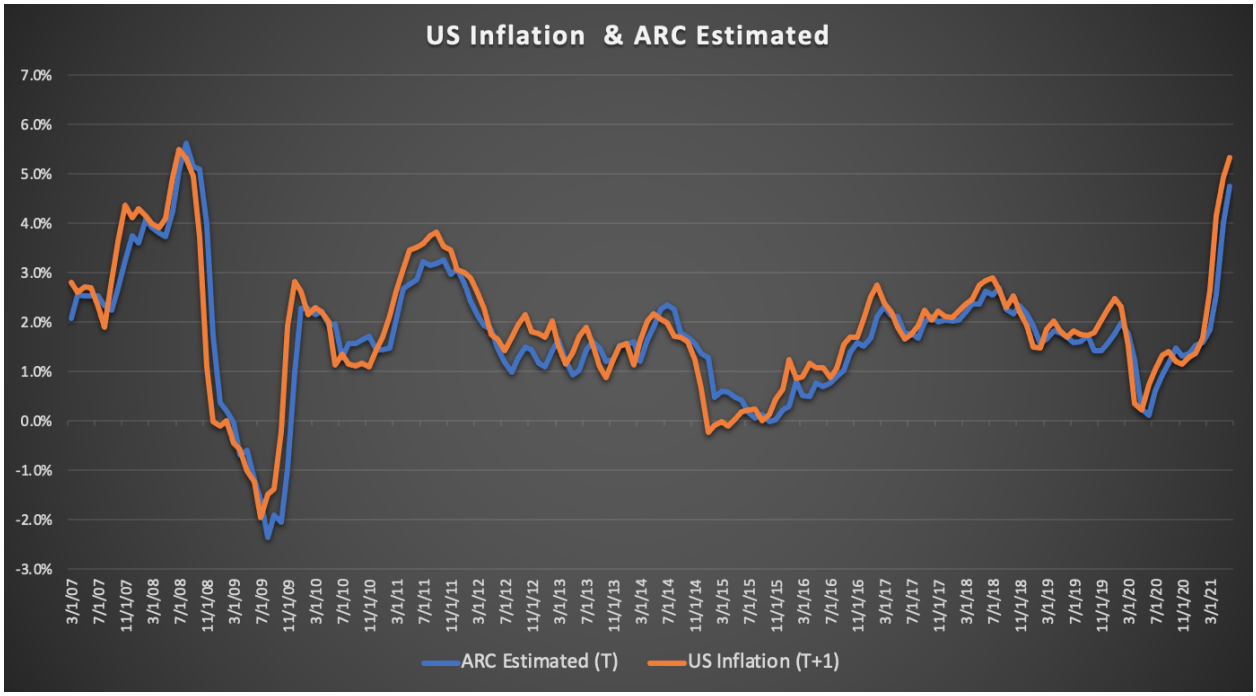
Factor	July-21	YTD	Historical Returns*	Volatility*
Basis	**0.73%**	**-3.8%**	**-5.3%**	**5.4%**
Open Interest	**-0.03%**	**1.6%**	**-0.7%**	**3.4%**
Momentum	**0.01%**	**2.3%**	**0.8%**	**4.7%**
ST Momentum	**-0.62%**	**-3.6%**	**-5.6%**	**5.2%**
Trading Activity	**0.03%**	**1.7%**	**0.3%**	**1.8%**
Volatility	**0.46%**	**10.7%**	**5.4%**	**6.0%**
ST Volatility	**1.40%**	**-2.5%**	**-2.3%**	**5.7%**

* Annualized 2017-2021

Mostly a flattish month for the Styles factor this month with the exception of ShortTerm (ST) Volatility and ShortTerm (ST) Momentum. Over the 4 year period 2017-2021, a short position in that factor would have delivered a Sharpe ratio of 1. This is consistent with a recent research ARC completed on 20 years of daily commodity and factor returns.

Consumer Prices Index and Inflation Estimates:

In a recent article, we demonstrate that the ARC Commodity factor model can model and predict changes in the Consumer Price Index (CPI). In particular ARC Commodity factors, such as Agriculture, Energy and some style factors, have statistically significant explanatory powers with respect to CPI one month ahead. Curiously, we find that Metals have no significant predictive powers versus CPI.
https://www.assetriskcompany.com/docs/ARC_CommodityModel_Inflation_202107.pdf



Graph1: US Inflation at time at T+1 vs ARC estimated with Factors at T

Our estimate for July CPI print (released on 8/13) is an increase of 0.78% or an index Value of 273.095. The July Inflation is estimated at 5.6%. We have now our first estimate for the August print (officially released on 9/14). Reach out to ARC to get more information.

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 each favoring its respective factor.

Table 3. Factor Tilted Portfolios and BCOM Performance

Returns	Value	Momentum	Low Vol	BCOM
2021	25.1%	21.2%	20.2%	23.4%
July 2021	2.1%	1.1%	1.0%	1.8%
Annualized*	11.8%	3.9%	5.7%	3.2%
Volatility*	15.4%	13.6%	9.3%	13.0%

*2017/2021

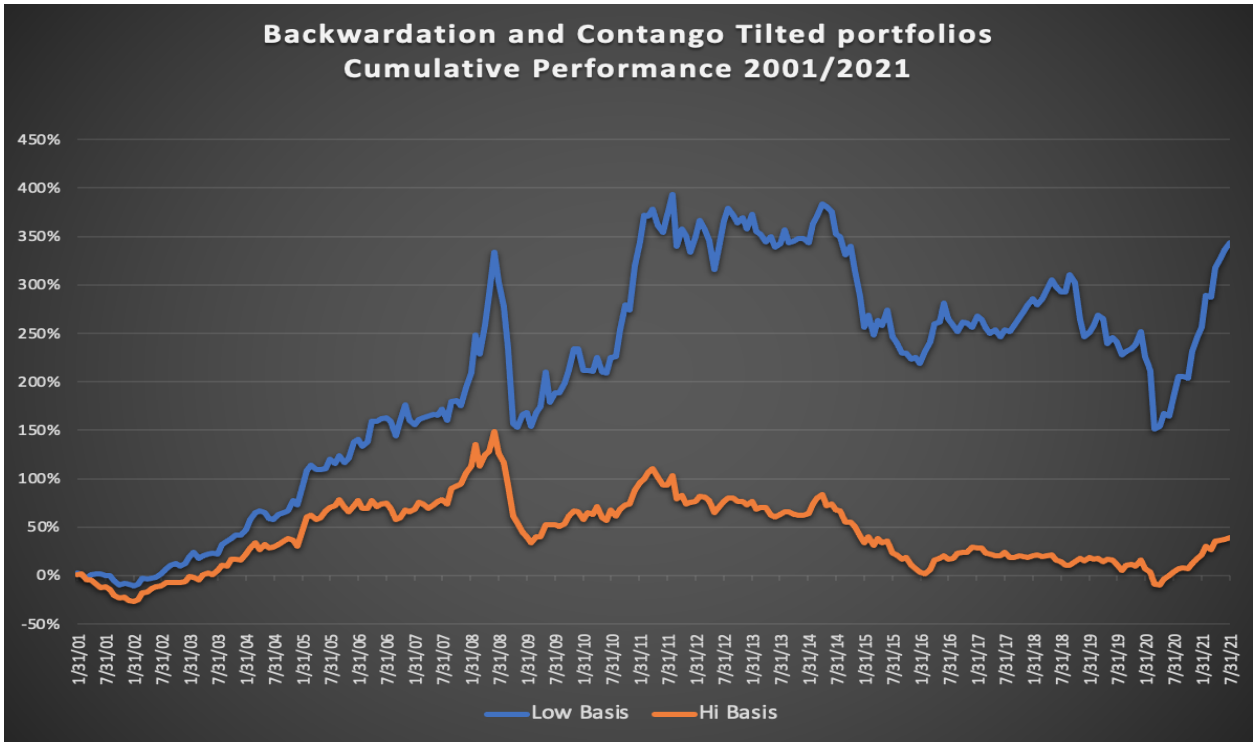
The Value tilted portfolio had a strong month and leads YTD. On a risk adjusted basis, all of the ARC Factor Replicating portfolios dominate the industry benchmark this year.

Backwardation and Contango Tilted Portfolio

One key feature of commodity futures (and futures in general) is the shape of the term structure. Futures products for which prices are higher in the front month than in the deferred contracts are said to be in backwardation while the opposite is defined as being in contango. The shape of the curve and change in the shape are key indicators that commodity professionals follow. The term structure of commodity futures is captured, in our factor model, by the Basis factor defined as the log difference of prices between a contract (at a maturity older than front month) and front month contract.

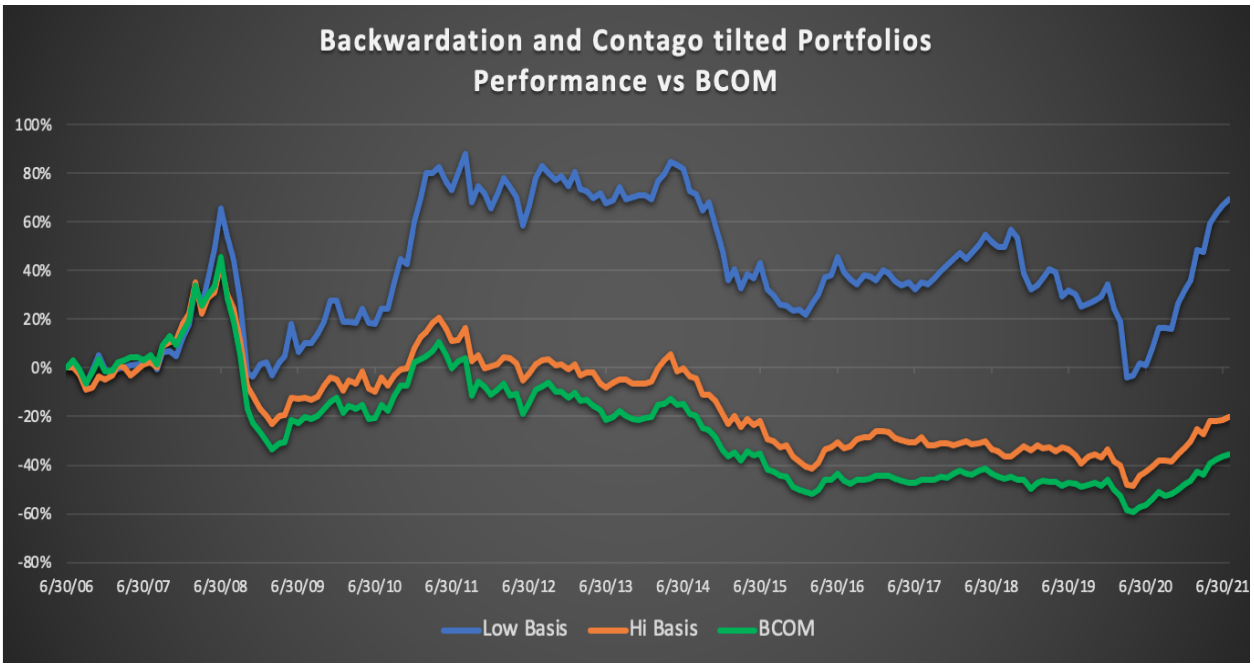
For the style factors, exposures are standardized (z-scores), and winsorized between -3 and 3. As described in the section above, we build and track tilted portfolios of all our factors. The Low Basis tilted portfolios will typically hold commodities futures in

backwardation while the High Basis tilted portfolios will be in contango. Below (Graph 2), we present the cumulative performance for both portfolios over a 20 year period.



Graph 2: Cumulative performance 2001/2021 for tilted portfolios in backwardation and contango

Clearly, portfolios titled towards Low Basis (backwardation) outperform significantly.
If we compare with the index BCOM (Graph 3), we can see that the backwardation tilted portfolio massively outperforms the BCOM index. The contango tilted portfolio, on the other hand, displayed similar performance to the index. This is a very key example why a factor model is so important. We have reduced the performance of the most followed commodity index to a trade on the curve. The ARC Commodity Model distills the important signals from the slurry of market prices.



Graph 3: Cumulative performance 2006/2021 for tilted portfolios in backwardation and contango vs BCOM

Factor Correlations:

Table 4. Factor Correlations

Correlations	Agriculture	Energy	Metals	Basis	Open Interest	Momentum	ST Momentum	Trading Activity	Volatility	ST Volatility
Agriculture	1.00	0.38	0.34	(0.18)	0.18	0.01	0.09	0.02	0.18	0.13
Energy	0.39	1.00	0.28	(0.09)	0.46	0.10	(0.09)	(0.12)	0.22	(0.03)
Metals	0.39	0.43	1.00	(0.14)	0.20	0.14	0.05	0.00	(0.02)	(0.05)
Basis	(0.47)	0.03	(0.12)	1.00	(0.09)	(0.14)	(0.22)	(0.03)	(0.06)	(0.17)
Open Interest	0.27	0.34	0.02	(0.24)	1.00	0.14	0.05	(0.49)	(0.18)	(0.31)
Momentum	0.52	0.43	0.41	(0.50)	0.24	1.00	0.15	(0.06)	(0.21)	(0.22)
ST Momentum	0.15	(0.32)	0.20	(0.18)	(0.09)	0.21	1.00	(0.15)	(0.31)	0.08
Trading Activity	0.08	0.14	0.33	0.15	(0.50)	(0.01)	(0.19)	1.00	0.08	0.23
Volatility	(0.30)	0.01	0.13	0.06	(0.50)	(0.18)	(0.21)	0.32	1.00	(0.26)
ST Volatility	0.24	0.31	0.14	0.12	(0.06)	(0.11)	(0.30)	0.35	(0.06)	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. 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. The proportion of risk coming from sectors vs styles is an approximate even split. 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	0.34	0.26
Energy	0.35	0.57
Metals	0.31	0.17
Basis	0.81	0.69
Open Interest	2.62	2.51
Momentum	0.48	0.57
ST Momentum	-0.09	0.03
Trading Activity	-0.25	0.19
Volatility	0.67	0.58
ST Volatility	0.53	0.41

Exposures, z-scores for BCOM and GSCI as of 7/30/2021

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. 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	**16.5%**	**17.4%**
Agriculture	2.2%	1.4%
Energy	3.4%	6.1%
Metals	2.8%	1.2%
Basis	-0.3%	-0.3%
Open Interest	7.4%	7.5%
Momentum	0.4%	0.6%
ST Momentum	0.0%	0.1%
Trading Activity	0.1%	0.0%
Volatility	0.0%	0.1%
ST Volatility	0.0%	0.2%
Specific Risk	3.8%	3.5%

Ex-Ante Annual Volatility Decomposition for BCOM and GSCI as of 7/30/2021

Conclusion:

In this report, we have shown the factor performance driving the commodity markets. We show that the ARC Factors can forecast CPI and Inflation. Using the ARC model, factor tilted portfolios are built 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.