ARC Commodity Factor Risk Model
Monthly Report January 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, and over 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. It provides a framework for managing risk and investment decisions.

In this report, you will find:

- Performance of Sectors, Sub-Sectors and Style Factors
- Examples of Factor Tilted Portfolios (Low Vol, Value, Momentum)
- Popular Commodity Index (BCOM, GSCI) Risk Factor Decomposition & Exposures
- Macro correlations of SPX, 10 Yr rate, DXY with our factors.

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

Factor Performance Report:

Factor	Jan-21 Perf	2020 Perf	Historical Returns*	Volatility*
Agriculture	1.6%	26.0%	6.1%	9.6%
Grain And Oilseed	2.7%	35.0%	8.4%	11.7%
Lumber And Pulp	10.7%	92.8%	28.2%	38.3%
Proteins	0.9%	7.5%	4.3%	9.7%
Softs	-1.6%	19.2%	0.6%	10.4%
Energy	4.5%	-16.9%	-6.9%	13.3%
Biofuels	16.8%	-2.6%	2.5%	19.6%
Coal	-0.9%	3.5%	4.0%	14.9%
Crude Oil	3.6%	-26.7%	-7.9%	16.1%
Natural Gas	3.2%	-13.7%	-8.9%	10.1%
Petrochemicals	6.0%	0.5%	-7.3%	17.5%
Refined Products	4.4%	-28.6%	-7.2%	19.5%
Metals	-5.1%	26.7%	12.2%	14.9%
Base	-5.1%	22.9%	10.3%	16.1%
Precious	-5.1%	38.7%	15.5%	17.6%

* Annualized 2017-2021

Factor	Jan-21 Perf	2020 Perf	Historical Returns*	Volatility*
Basis	**-0.6%**	**5.0%**	**-5.1%**	**5.7%**
Open Interest	**1.2%**	**-4.5%**	**-0.9%**	**3.3%**
Momentum	**1.9%**	**-4.0%**	**0.8%**	**4.8%**
ST Momentum	**-2.2%**	**-5.9%**	**-5.9%**	**5.1%**
Trading Activity	**-0.5%**	**1.1%**	**-0.2%**	**1.8%**
Volatility	**3.3%**	**14.3%**	**4.3%**	**5.7%**
ST Volatility	**-2.2%**	**0.6%**	**-2.5%**	**5.9%**

* Annualized 2017-2021

After a very good 2020, Metals were down this past month, both Base and Precious (-5.1%). Palladium and Gold were the products driving Precious Metals performance. The annualized return over the last 4 years for Precious Metals has been impressive and it will be interesting to see if the trend continues. Will the end of the pandemic negatively impact the sub-sector or will fear of inflation help? Additionally, the effect of the WallStreetBets online community is helping to drive gains in Silver. While the commodity markets are driven by sophisticated investors with the wherewithal to handle large value contracts, the small investor community has shown itself to be a force. It will be interesting to see if they can move the sector and sub-sector, in turn triggering widespread rebalancing and a contagion effect.

Energy had a good start after a devastating 2020. Crude Oil and Natural Gas are positive but we would like to highlight the Biofuels sub-sector. Undoubtedly, the new President's "green policies" are igniting the performance of these commodities.

Again the Lumber and Pulp sub-sector is still on a roll after a fantastic 2020 performance. The post COVID exit from the central business district continues unabated. The new housing required has fueled this boom.

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.

On the Styles side, we notice that the Volatility and Short Term Momentum Factors continue their historical and recent trend. Volatility is defined as the 252 day (one business year) historical volatility for each future in the model. Starting in April 2020, the factor return has been on an upward trajectory and posted again an impressive month (+3.3%). ST Momentum, defined as the last 30 days returns is down -2.2% this month in line with historical trend. If one was able to isolate these factors there will be a decent risk return ratio. FMPs (Factor Mimicking Portfolios) provide such features but they tend to be composed of a large number of the model assets. If one were to trade these portfolios there are problems with the size of a portfolio needed in order to avoid fractional futures positions. This in turn would aggravate liquidity problems in the more thinly traded products and expiries. A feasible replication of the Volatility and ST Momentum Factor Mimicking Portfolios with a smaller but liquid group of futures might be an interesting application of the model[1].

Factor Tilted Portfolios Performance Report:

In order to illustrate the power 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. The other two portfolios are similarly constructed.

All three tilted portfolios outperform the major commodity index in 2020. In particular, the Low Vol portfolio returned 7.5%. Over the last 4 years all factor tilted portfolios outperform the index. Noticeably, the Value tilted portfolio annualized return is 7.7%. These portfolios are composed of some of the most liquid commodity futures and

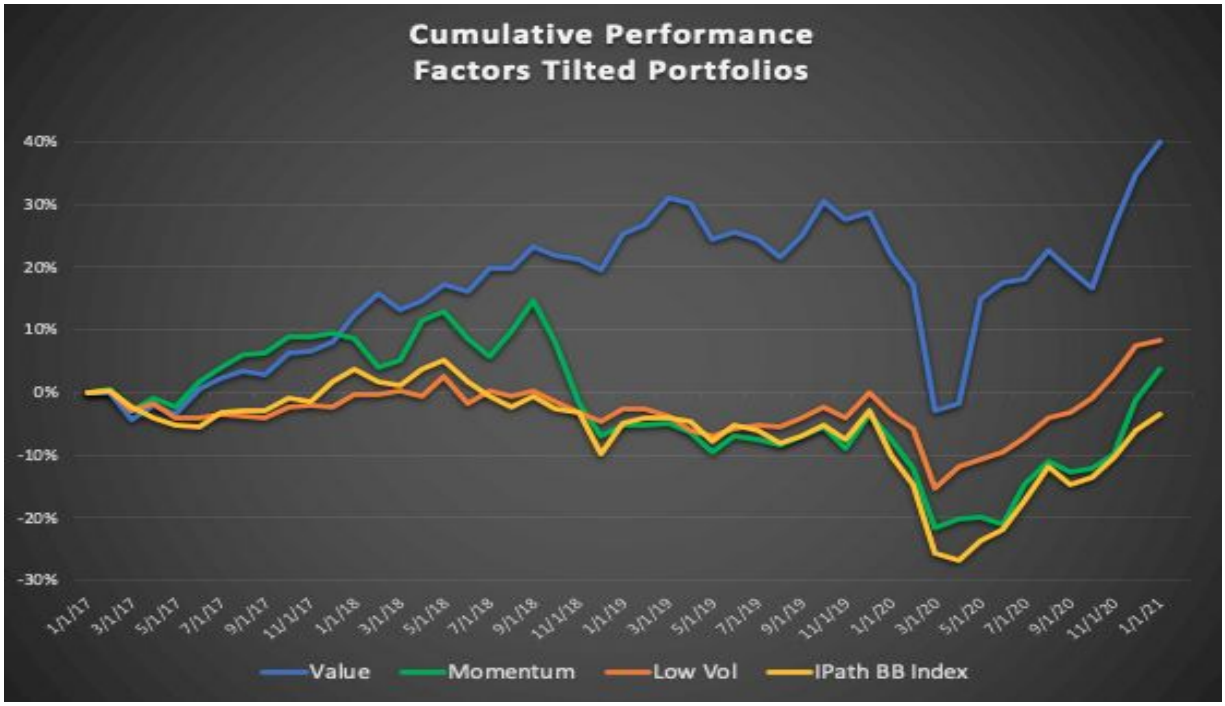
[1] ARC is a model vendor not an asset manager. We point out something that a user might investigate with our model.

rebalanced once a month. The simplicity of the portfolios, their low turnover and excellent liquidity make them more than suitable benchmarks against which one might judge actively managed portfolios.

In January both the Value and Momentum tilted portfolios outperformed BCOM.

Returns	Value	Momentum	Low Vol	IPath BB Index
2020	4.7%	2.5%	7.5%	-3.1%
January 2021	3.9%	4.8%	0.8%	2.6%
Annualized*	8.6%	0.9%	2.0%	-0.9%
Volatility*	15.8%	13.8%	8.8%	12.6%

*2017/2021



Factor Correlations:

Correlations	Agriculture	Energy	Metals	Basis	Open Interest	Momentum	ST Momentum	Trading Activity	Volatility	ST Volatility
Agriculture	1.00	0.55	0.46	0.18	0.20	(0.30)	(0.31)	(0.16)	0.34	0.27
Energy	0.45	1.00	0.41	(0.30)	0.36	(0.32)	(0.40)	(0.11)	0.18	0.25
Metals	0.27	0.05	1.00	0.06	0.13	(0.17)	(0.24)	(0.11)	0.08	0.27
Basis	(0.30)	0.04	(0.37)	1.00	0.07	0.02	0.01	(0.10)	0.12	(0.14)
Open Interest	0.30	0.37	0.17	0.04	1.00	(0.20)	(0.21)	(0.33)	0.00	(0.02)
Momentum	(0.14)	(0.11)	0.13	0.16	(0.09)	1.00	0.33	0.03	(0.13)	(0.13)
ST Momentum	0.15	(0.06)	0.38	(0.23)	0.17	0.04	1.00	0.01	(0.22)	0.02
Trading Activity	(0.38)	(0.48)	(0.17)	0.06	(0.65)	(0.19)	(0.27)	1.00	0.03	(0.03)
Volatility	0.34	0.29	0.16	(0.26)	(0.12)	(0.28)	(0.44)	0.05	1.00	(0.57)
ST Volatility	0.25	(0.13)	(0.19)	(0.12)	(0.21)	(0.14)	0.23	0.20	(0.34)	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, with only the Metals/Energy correlation changing dramatically. In the Style camp, the Momentum exposure's correlation to the other style factors has changed drastically. This might be something to monitor.

Commodity Indices Risk Decomposition

Next we calculate risk factor decompositions of the two major commodity indices using the ARC short term model as of 01/29/2021. The Bloomberg Commodity Index allocation is more even while GSCI is overweight in energy. Both have significant exposure to Open Interest, reflecting a bias towards the front of the curve (short maturity contracts are more volatile). The Volatility factor contribution is significant for GSCI due to an overweight in volatile futures, mostly in the energy sector. Styles factors contribute to 50% and 54% of the total volatility for BCOM and GSCI.

As a reminder, the exposures to sectors and sub-sectors are simply 1 or 0. ARC sector returns come from a regression model and not from a manual weighing of commodities in each sector. For the style factors, exposures are standardized (z-scores) and winsorized (between -3 and 3). As one might imagine, an exposure of 0 corresponds to the mean. A negative exposure means the asset is less exposed to that factor than the

average of the assets in the model. Conversely, a positive exposure reflects the fact that the asset has more exposure than the average. The model's exposures are computed daily for more than 1,200 commodity futures. ARC's model comes in a nested format. This means two models are jointly estimated in such a way that the explanatory power of the **style factors** is unchanged whether looking from a higher level aggregation of the data or lower level (sub-sector) aggregation.

Index	BCOM	GSCI	BCOM Contribution	GSCI Contribution
Total Risk	21.3%	24.0%	100%	100%
Agriculture	3.3%	2.4%	15%	10%
Energy	3.6%	7.0%	17%	29%
Metals	3.4%	1.4%	16%	6%
Basis	0.5%	0.4%	2%	2%
Open Interest	8.5%	7.0%	40%	29%
Momentum	-0.5%	0.0%	-3%	0%
ST Momentum	-0.7%	-1.2%	-3%	-5%
Trading Activity	0.4%	0.5%	2%	2%
Volatility	1.6%	6.1%	8%	25%
ST Volatility	0.9%	0.0%	4%	0%
Specific Risk	4.1%	4.4%	19%	18%

Macro Correlations

Commodities as an asset class are often seen as a diversifier. They also can be used as a hedge against inflation. To this effect, we track the 6 month rolling correlations between our Agriculture, Energy sectors, and the Precious Metals sub-sectors vs the

S&P 500, the 10-year breakeven inflation rates and the Dollar Index (DXY) (basket of currencies vs $). After a spike due to the Covd-10 pandemic, correlations between the equity market and commodities are back to low values (see Graphs below). We see similar features with the 10-year breakeven inflation rates.

We then looked at the rolling correlation with the DXY index. We can clearly see that the correlations between the Dollar Index and Precious Metals are on a downward trend currently at -0.6[2]. The Dollar Index has weakened while Precious Metals had a very good year. Expectations are for the Dollar to continue to weaken as the recovery of the pandemic will trigger a rotation away from US assets. It will be interesting to see how the correlations continue to evolve vs Precious Metals.

[2] Recall that using the Fisher transformation, we can calculate the standard error of the correlation coefficient as approximately SQRT(1/(N-3)) where N is the sample size. Using the sample size N = 125 gives us the result that +/- 0.09 is the standard error. Implying anything beyond +/- 0.2 is significant.

Conclusion:

In this report, we have shown the factor performance driving the commodity markets.The performance of the markets was centered on Lumber, Biofuels and other Energy related subsectors (some of which were offsetting). 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 beat. We then conducted an analysis into the risk dynamics of the two major commodity indices. Finally, we show the correlations between the factors and major economic indicators. 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.