



ARC Commodity Factor Risk Model Annual Report 2021

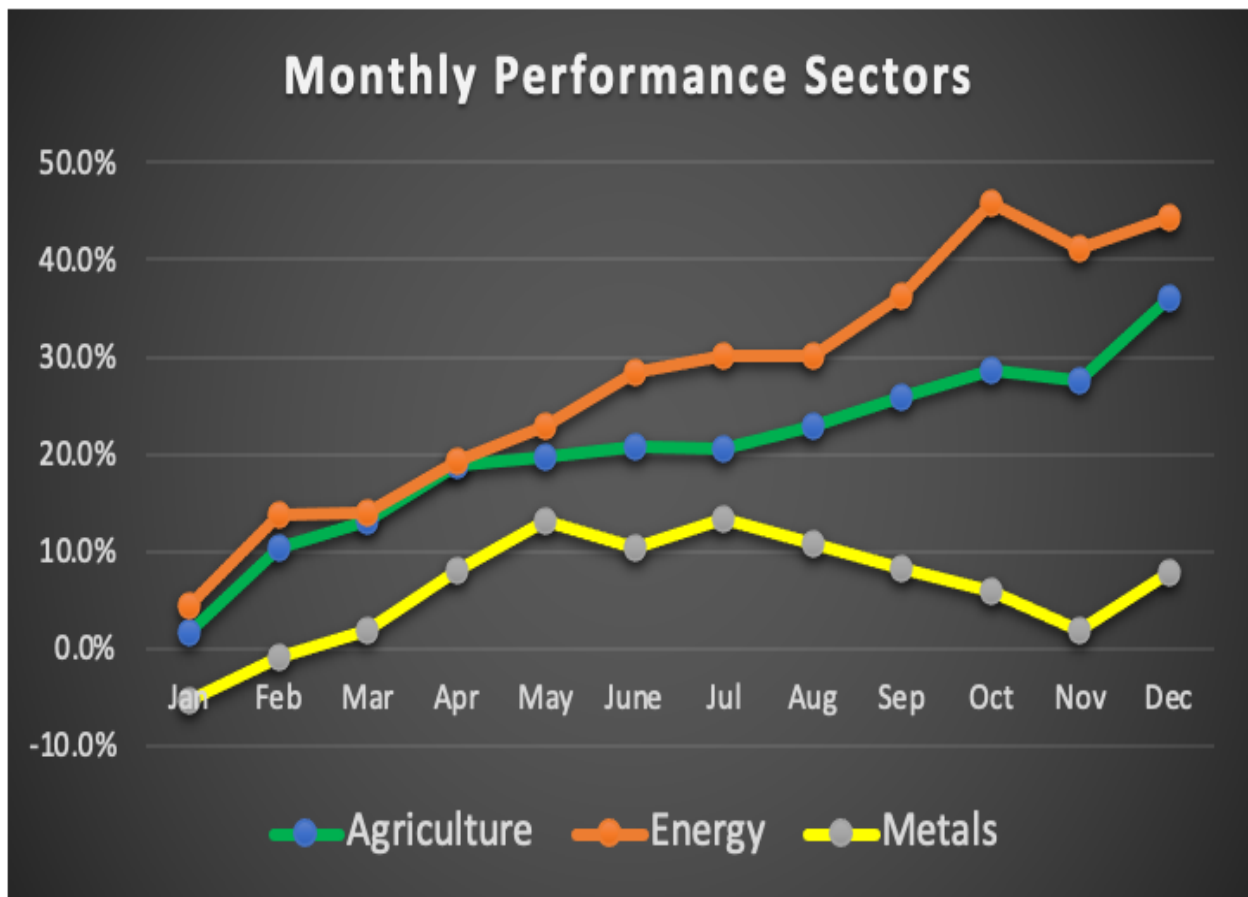
Following a scorching 2020, it would have been natural for an observer to forecast a slower more consolidating pace for 2021. With the exception of precious metals, every subsector was up double digits. All of the sectors (upper level aggregation) were up double digits. Generally, 2021 could be characterized as commodities catching fire. The real part of the economy woke up, decided it needed more of everything and bid up prices!



Sectors and Factors Performance Report:

Month by month, both sector and subsector groupings show one of rising cumulative returns.

Graph 1. 2021 Sectors and Subsectors Performance





Recall that the construction of the model is such that the returns in Table 1 are blended returns of the entire term structure of each grouping. Had one looked at the product level and beyond, there would have been even more spectacular performance.

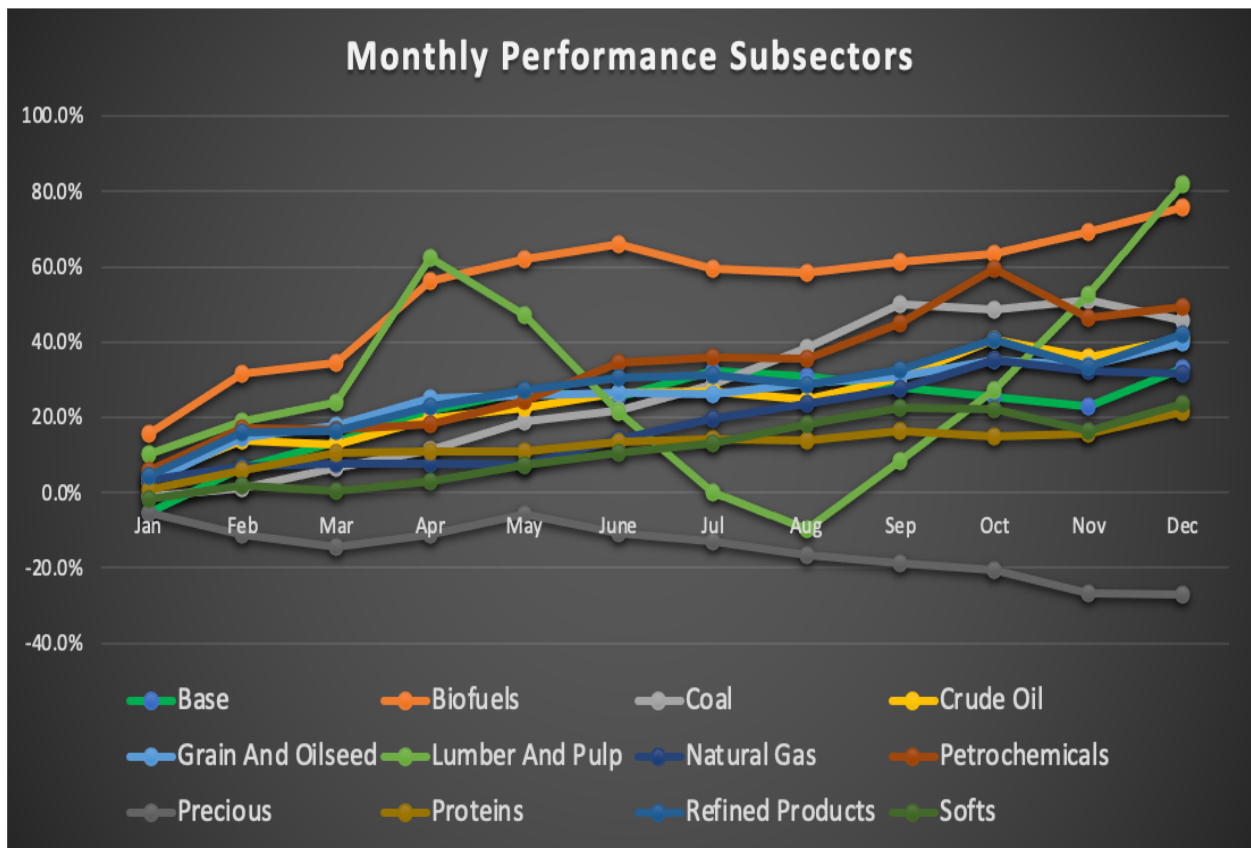




Table 1. Sectors and Subsectors Performance

Sectors	2021	2020	5 Yr Returns	5 Yr Volatility
Agriculture	36.9%	26.0%	11.4%	10.3%
Grain And Oilseed	42.3%	35.0%	14.0%	12.1%
Lumber And Pulp	71.0%	92.8%	33.6%	48.0%
Proteins	19.7%	7.5%	7.1%	9.7%
Softs	22.8%	19.2%	5.0%	11.5%
Energy	40.1%	-16.9%	0.0%	13.6%
Biofuels	77.8%	-2.6%	11.0%	21.4%
Coal	41.8%	3.5%	10.9%	17.3%
Crude Oil	37.6%	-26.7%	-1.0%	16.2%
Natural Gas	27.5%	-13.7%	-3.3%	10.7%
Petrochemicals	40.5%	0.5%	-0.6%	18.7%
Refined Products	39.9%	-28.6%	-0.2%	19.3%
Metals	16.9%	26.7%	14.5%	15.0%
Base	50.7%	22.9%	18.8%	18.1%
Precious	-17.7%	38.7%	9.3%	17.0%

2021 was an exceptional year for commodities, but if we look at the data over the last 5 years (Graph 2), we can see that these sectors were mostly flat until the Covid-19 crisis. We think to understand better where commodities might be headed in the near future, it makes sense to look at the performance since the Covid-19 crisis. In Table 2 we show the cumulative returns since 3/31/2020.



Graph2: Cumulative Performance ARC Sectors 2017/2021



Lumber & Pulp is up almost 300% since Covid-19! Grain and Oilseed showed a +101.8% return, Biofuels +153.6%, and Base Metals +116.6%, all triple digits returns. We annualized the returns and volatility for each sector and subsector over this period. Most of them have a Sharpe ratio above 1.5. Grain & Oilseed has a Sharpe ratio of 3.9!

Table 2. Sectors and Subsectors Performance since 3/31/2020

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Sector	Total Perf	Annualized Returns	Volatility	Sharpe Ratio
Agriculture	86.0%	42.6%	11.1%	3.8
Grain And Oilseed	101.8%	49.4%	12.6%	3.9
Lumber And Pulp	293.6%	118.8%	69.3%	1.7
Proteins	45.0%	23.6%	8.5%	2.8
Softs	55.5%	28.7%	13.4%	2.1
Energy	52.5%	27.3%	11.9%	2.3
Biofuels	153.6%	70.2%	23.5%	3.0
Coal	69.0%	34.9%	21.6%	1.6
Crude Oil	39.4%	20.9%	16.1%	1.3
Natural Gas	28.9%	15.6%	11.0%	1.4
Petrochemicals	74.0%	37.2%	18.6%	2.0
Refined Products	51.0%	26.6%	15.0%	1.8
Metals	67.1%	34.1%	18.4%	1.9
Base	116.6%	55.5%	21.7%	2.6
Precious	19.2%	10.6%	21.9%	0.5

These returns and Sharpes are the types of metrics hedge funds managers dream about! Are these returns sustainable? Covid-19 has disrupted our lives beyond anything we have ever witnessed. That disruption has carried through the economy. Pressure on key commodities like Agriculture and Energy has been tremendous. These effects have been felt by consumers as inflation is now at a 40 year highs. It would be really surprising to see such return/risk ratios over the longer term (5 year+), especially so broadly across all sectors/subsectors. However it may be too early to write off the effect

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of this pandemic, the adjustment process is probably still not finished. Last month for instance, showed significant performance for commodities.

We apply a similar analysis to the Style Factors of the ARC Commodity Model.

Table 3. Styles Performance since 3/31/2020

Factor	Total Perf	Annualized Returns	Volatility	Sharpe Ratio
Basis	-8.3%	-4.8%	3.7%	-1.3
Open Interest	0.9%	0.5%	4.3%	0.1
Momentum	-4.4%	-2.6%	5.6%	-0.5
ST Momentum	-17.1%	-10.2%	5.7%	-1.8
Trading Activity	5.3%	3.0%	2.7%	1.1
Volatility	30.5%	16.4%	7.2%	2.3
ST Volatility	-3.6%	-2.1%	8.9%	-0.2

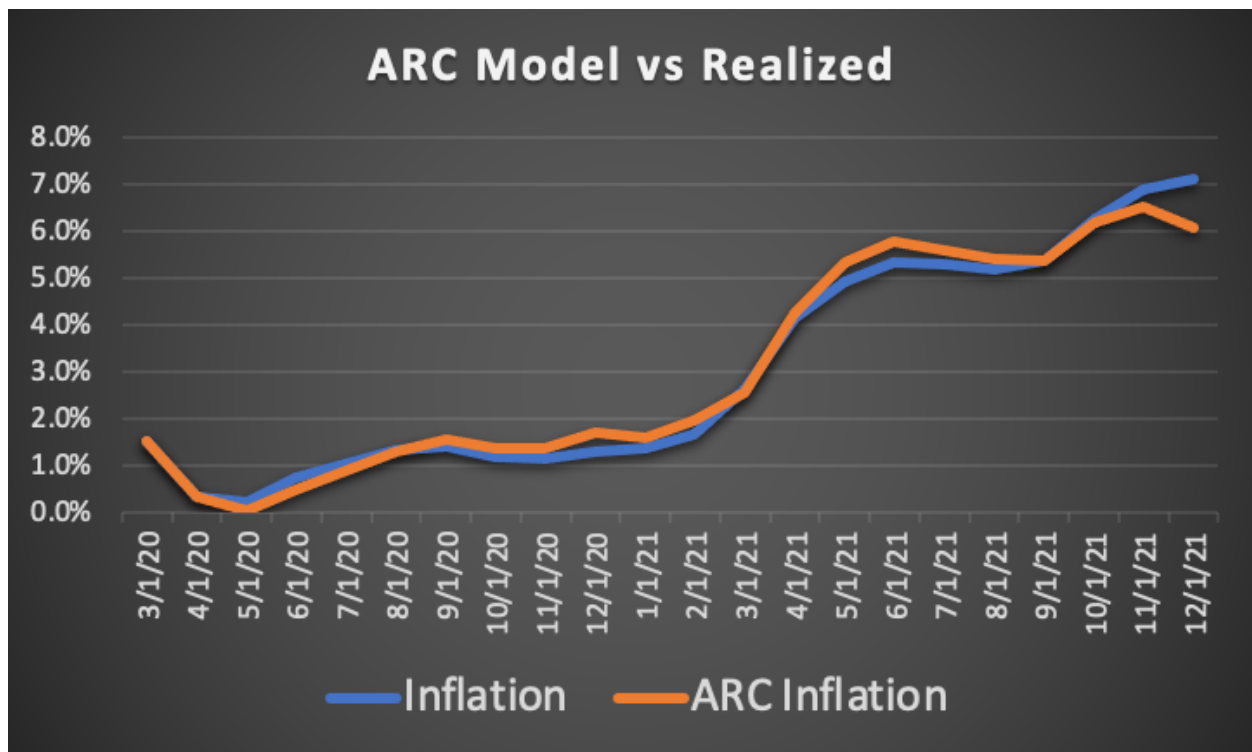
As our research showed over the last 20 years, Short Term (ST) Momentum exhibits constant return/risk ratio above 1. In the shadow of the Covid-19 pandemic, the Sharpe is actually closer to 2. This is for a short position of the factor. Basis, as well, displays some nice features. The best performing factor over that period is the Volatility factor. We define Volatility as the historical 252 day volatility for each futures in the model (the exposures are z-scores). We know from measuring correlations between our factors that the model is able to separate returns coming from sectors/sub-sectors and styles. Short Term Momentum, Basis and Volatility are factors that can be used to tilt a portfolio towards higher returns or lower risk.



Inflation:

Another application of a commodity factor model is inflation forecasting or attribution. With inflation at 7% in December, expectations are high for 2022. Will inflation decrease as the Fed thinks or will it continue to increase due to a slow post-pandemic recovery or a structural change in our economy? 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. Just as in the previous section we focus on our analysis since the Covid-19 crisis. The graph below shows realized inflation vs ARC estimated inflation since 3/31/2020. The R-Squared over that period is 98%. Our model used sectors and factors returns from the current month and one month lag. It is estimated at the end of the month so 10 days prior to the release by the BLS.

Graph 3. Inflation model





To wit, inflation is the percentage change of the CPI index over 12 months. Therefore it is dependent on the latest CPI change but also the one that left the 12 months interval. In the first quarter last year, the successive increases were 0.4%, 0.5% & 0.7%, certainly a tall order to follow if inflation were to continue to increase.

Styles Tilted Portfolios Performance Report:

Our analysis of 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. Our Research indicates that 3 styles tilted portfolios over perform the index: Value (Low Momentum tilted), Low Volatility and Backwardation (Low Basis tilted portfolio). 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 4. Factor Tilted Portfolios and BCOM Performance over the last 5 years

Year	Value	Momentum	Low Vol	Backwardation	BCOM
2021	33.4%	24.8%	27.9%	32.4%	27.1%
2020	8.2%	4.1%	8.0%	2.4%	-3.1%
2019	8.7%	3.8%	5.0%	5.0%	7.7%
2018	11.2%	-13.9%	-2.2%	-1.8%	-11.2%
2017	8.4%	9.8%	-2.0%	4.6%	1.6%
Annualized	13.6%	5.0%	6.8%	7.9%	3.6%
Volatility	15.0%	14.5%	9.2%	15.6%	13.3%

Value had a blistering 5 year performance with annualized return of 13.6% vs 3.6% for BCOM, for a similar level of volatility. Low Vol provided annualized almost double BCOM



for a realized volatility 70% lower. Finally, Backwardation provides more than twice the returns from BCOM for similar volatility. We show returns for high Momentum tilted portfolios as this is a popular style, but do not recommend it as tilt.

Performance Attribution using Styles Only:

The advantage of the ARC model is the ability to break down returns from commodity futures between Sectors/Subsectors and Style factors. Most risk and performance attributions are focused on sector allocation. It is well known, for instance, that the main difference between BCOM and GSCI is the energy allocation. GSCI is overweight in Energy futures, while BCOM tends to be more equi-weighted between Energy, Agriculture and Metals. For 2021, GSCI outperformed BCOM (+40.4% vs 27.1%).

In this section we take a different tack. If we ignore the sector and subsector differences in either index and attribute their returns to styles only. We take the style tilted portfolios from the previous section to explain BCOM and GSCI returns for 2021. The style tilted portfolios are employed because they are very tradeable. We use 5 years of monthly data to calibrate the regression. The R-Squared was around 80% with statistically significant p values.

Table 5. 2021 Performance Attribution

Styles Indices	BCOM	GSCI
Value	8.5%	30.8%
Momentum	10.2%	11.3%
Low Vol	10.2%	-16.2%
Backwardation	0.6%	18.2%
Total	29.5%	44.1%

The total performance is close to realized (+27.1% for BCOM and +40.4% for GSCI).



Through this prism we see that the drivers of returns for both indices are different. Value is defined as Low momentum futures (12 minus 1 definition for momentum). BCOM returns are mostly equi-weighted between Value, High momentum and Low Volatility. While GSCI is most heavily driven by Value, then Backwardation (Low Basis tilt) and then High Momentum. Noticeably GSCI has a negative exposure to Low Volatility.

Conclusion:

The ARC Commodity model has proven itself as a way to understand the forces affecting commodity prices and returns. The broad based effect has been of a runaway bull market in commodities. Peering beneath the surface we see that the most consumer facing commodities, Agricultural and Energy, were the ones that showed the most significant acceleration. This in and of itself suggests that perhaps there will be some equalization with the odd man out, Metals. Digging deeper, we see that precious metals did not participate meaningfully in this rally. Again, this suggests some sort of reversion-either the other subsectors come down or precious metals are the laggards that will follow the others up. We see that the performing sectors and subsectors did so consistently throughout the year. There was not necessarily a standout month. The Metals sector weakened towards the 3rd quarter of the year-perhaps reflecting some recessionary/stagflationary pressure building in the economy.

The analysis of 2021 would not be complete without looking back at 2020. It turns out that had someone applied the ARC Model, there was enormous premium to shorting Short Term Volatility. This mean reversion would have been easy to spot in oil, but the model allows a trader to find the same effect in other commodities-illuminating what is often lost in the soup of maturities and products.

A five year retrospective of our Factor Replicating portfolios shows that not only is Factor Investing possible in commodity markets, but that it trounces the industry standard index. It is possible to deliver Low Volatility (ex-post low volatility in fact) portfolios in notoriously volatile markets. Moreover, our definition of Value performs on an absolute and risk adjusted basis. The tools that work in Fixed Income and Equities



also seem to work in commodities. The uninformed investor ignores this to their detriment.

The model was applied to inflation forecasting as an example of what one might do with it. We show that the model was quite accurate. It correctly forecast (10 days ahead) major moves in consumer prices.

We close with a wish for a less wild 2022, but should the froth persist we hope that you will use our model to navigate the perilous waters.

About the Model:

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.

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>.

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.

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