



## What Factor Models Tell Us About Curve Strategies

In this note we look at commodity curves strategies through the prism of a risk factor model. We show how traditional style factors allow us to model and quantify risk associated with curves based strategies. In particular the model cleanly separates sector allocation and style factors. We identify two style factors that allow us to measure the impact of curve strategies. Factor models are rare in commodity and curve related markets. To our knowledge, there are no examples of this type of research.

Curve based strategies involve positions on different maturities of commodity futures contracts. It can be a spread strategy, long/short a commodity contract with different maturities or roll yield strategies.

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. Styles factors include Basis, Momentum (long term and short term), Open Interest, Trading Activity, Volatility (LT and ST). Basis is defined as the difference of returns between the contract at maturity  $t$  and the front month. On a daily basis we standardize and winsorize exposures. For all assets in the model, the exposures (or z-scores) are between -3 and +3. The average for the model is 0, meaning a futures with a positive exposure is more sensitive to this factor than the average.

To better illustrate we plot the Basis exposures of Crude Oil (CL) and Natural Gas (NG) contracts along their maturity dates (Figure 1). The exposures to Basis drop as the maturity of the Crude Oil contract increases, reflecting the current backwardation of oil. The seasonality of the Natural Gas contract is clearly visible with a peak around the winter injection period and troughs in the early springs.

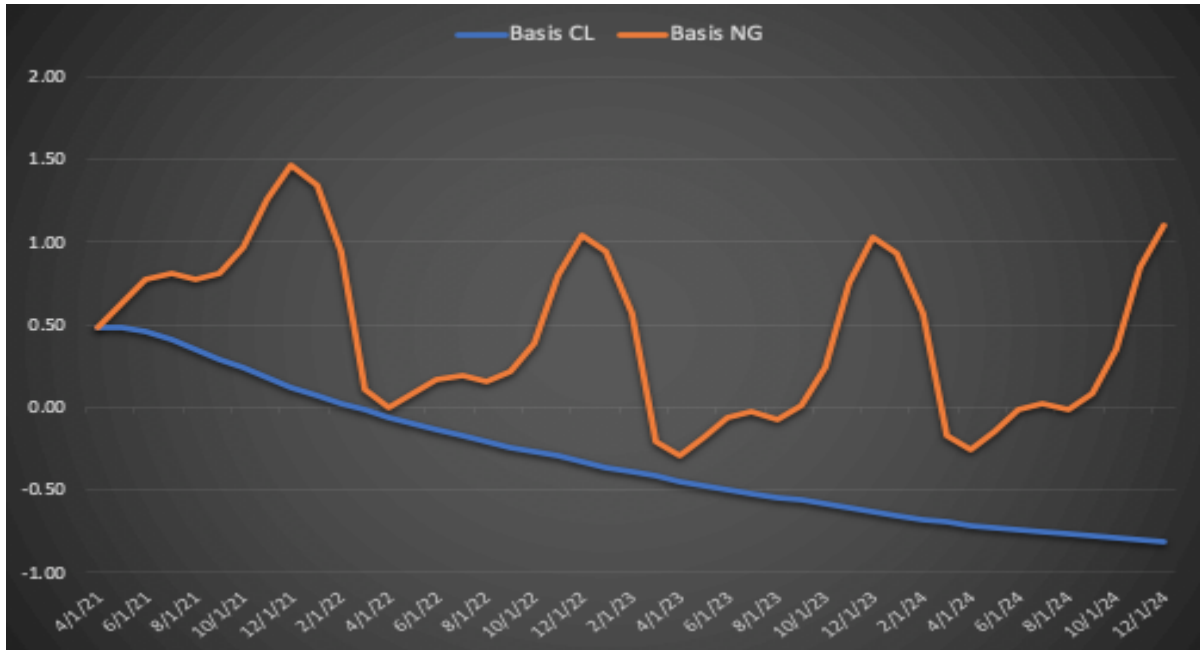


Figure 1: Crude Oil and Natural Gas Basis Exposures for increased maturities (as of 3/31/2021)

Next we look at all style exposures for the Crude Oil contract over the maturity curve (Figures 2 and 3). As expected, the exposures that measure Open Interest and Trading Activity will decrease over time. However we notice a spike every 6 months, clearly indicating increased trading for winter and summer seasons. Also Volatility factors will come down with maturity.

Overall we show that the Style factors capture the differences associated with a contract curve. As described above, the ARC Commodity model provides exposures to 50 commodity contracts with all their maturities. Exposures are standardized, meaning we now have the same metric/base to consistently compare all types of commodities across different maturities.

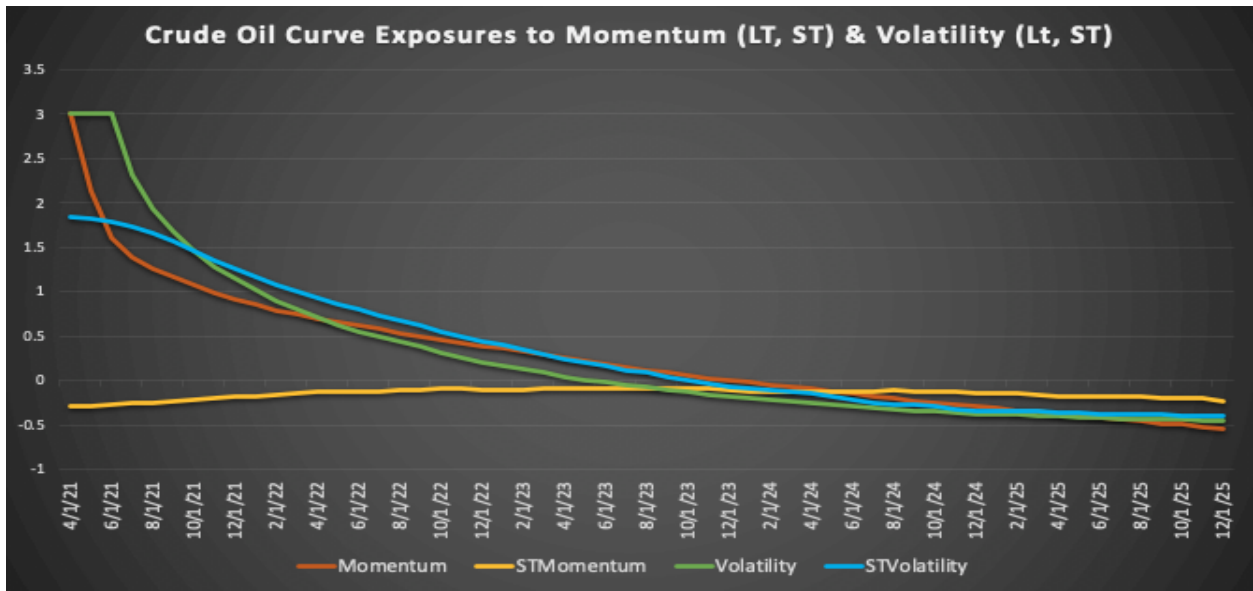
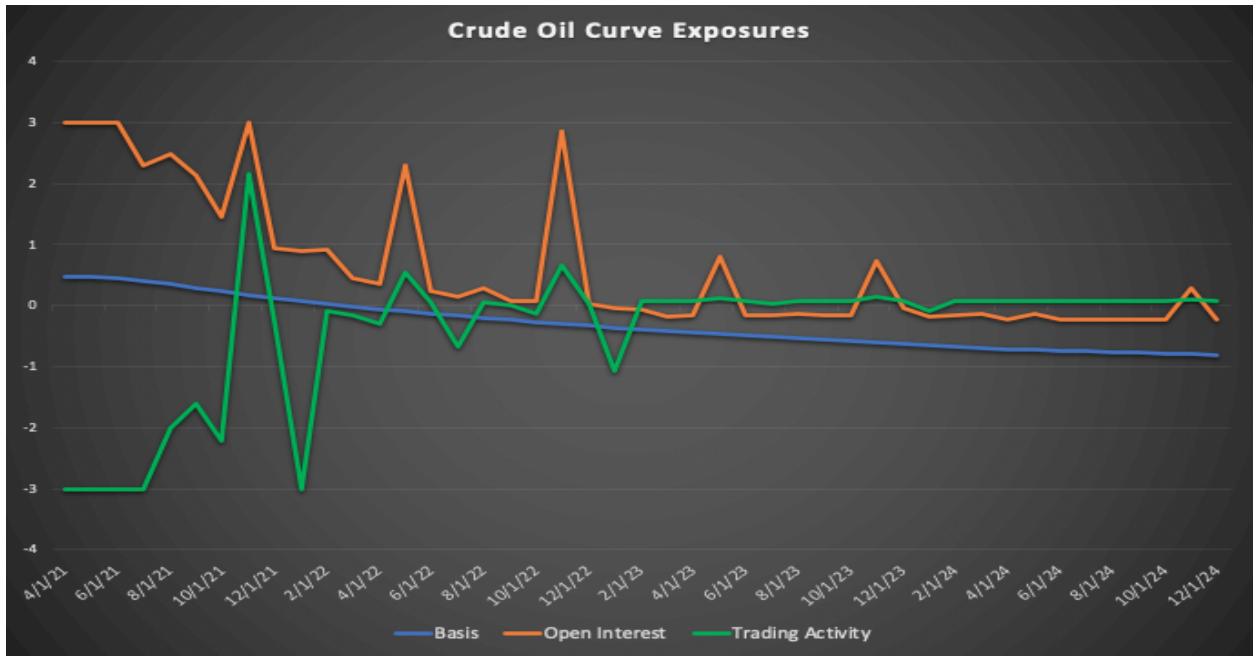


Figure 2 & 3: Crude Oil Exposures to Style factors for different maturities as of 3/31/2021



To illustrate that point we look at a portfolio of commodities. In particular we look at the BCOM index and construct a similar index for which we select the same commodities and weights but with a constant forward maturity of 6 months. In Table 1, we provide sectors and styles exposures.

Factors	BCOM	BCOM FWD 6m
Agriculture	0.36	0.36
Energy	0.32	0.32
Metals	0.32	0.32
Basis	0.49	0.23
Open Interest	2.64	0.89
Momentum	0.85	0.29
ST Momentum	-0.65	-0.62
Trading Activity	-0.91	-0.04
Volatility	0.66	0.05
ST Volatility	0.36	0.15

Table 1: Exposures for BCOM and index FWD 6m as of 3/31/2021

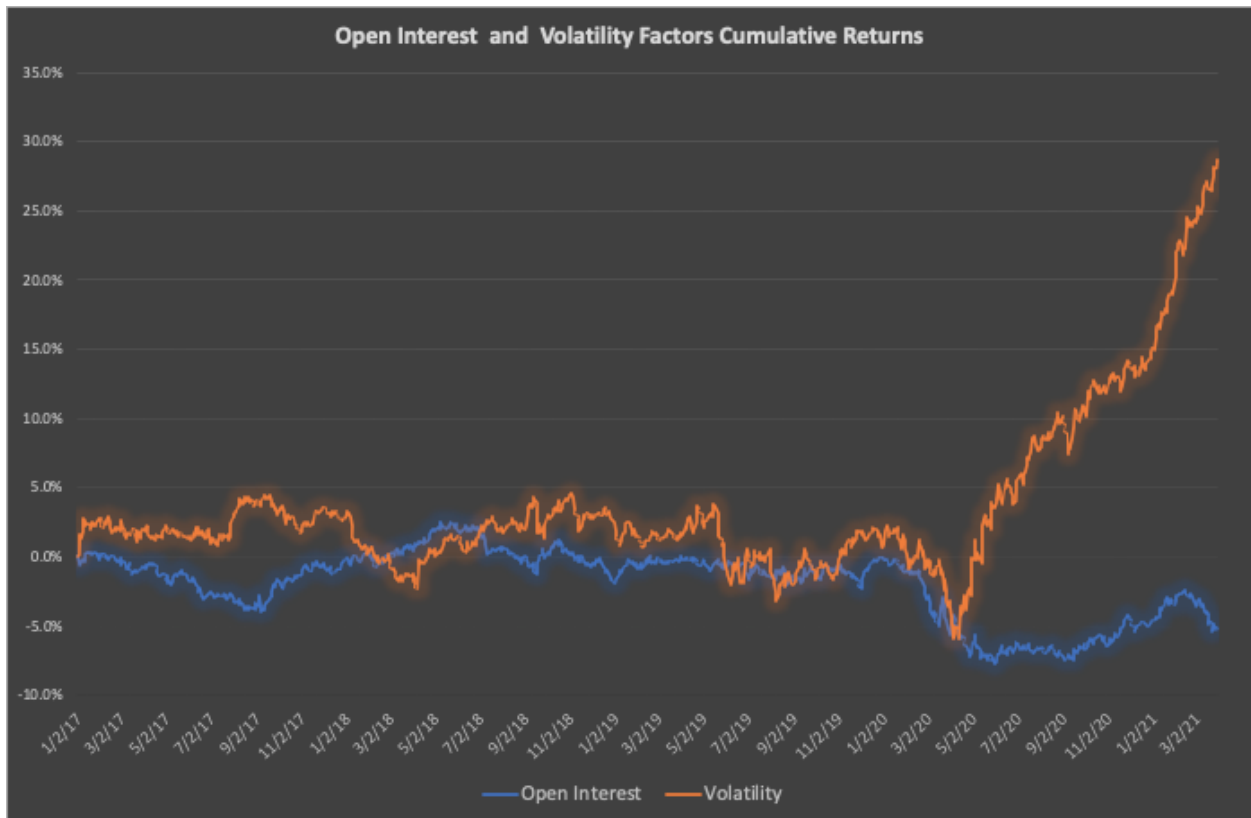
We notice the biggest exposure differences between the two indices are for Basis, Momentum, Trading Activity and Volatility. Volatility is defined as the 252 day (one business year) historical volatility for each future in the model. Momentum is the usual twelve minus one definition, while Trading Activity is the daily change in volume.

Basis, Momentum and Trading Activity will not always be larger for portfolios with futures with longer maturities. Basis will be a combination of contracts in backwardation and contango and therefore dependent on the weightings and contracts. For Momentum, there is no reason why short date maturities will always have larger



Momentum. This is also true for Trading Activity. It will be dependent on market conditions.

Open Interest and Volatility are key indicators depending on the maturity of the contracts. For most futures, front months have the most liquidity and tend to be more volatile as well. It is interesting to look at the cumulative returns of the two factors (Graph 1). As noted in the last few months in our monthly report, the Volatility factor performance has shot up since the Covid crisis.



Graph 1: Cumulative Returns for Open Interest and Volatility Factors, 2017-2021

Next (Table 2), we now look at the ex-ante annualized volatility for both indices and their risk factor attribution. The contributions of all factors sum-up to the systematic volatility. The total variance is the sum of the systematic and specific variance.



Factors	BCOM	BCOM FWD 6m
Total Risk	18.9%	12.6%
Agriculture	2.3%	2.5%
Energy	3.1%	3.2%
Metals	2.6%	3.5%
Basis	0.0%	0.0%
Open Interest	7.7%	2.0%
Momentum	-0.1%	-0.1%
ST Momentum	0.8%	0.9%
Trading Activity	0.5%	0.0%
Volatility	1.8%	0.1%
ST Volatility	-0.4%	0.0%
Specific Risk	3.9%	3.3%

Table 2: Ex-Ante Annual Volatility Decomposition as of 3/31/2021

As expected the BCOM is more volatile. The two indices have, by construction, the same sectors allocation and differ by the maturities of the individual futures. Intuitively, the level of risk coming from the sectors should therefore be similar if the model is able to separate effectively the sector from style risk. This is exactly what we observe: the sectors' total volatility is 8% for BCOM vs 9% for the same index with 6 months forward contracts. The styles contributions differ massively reflecting the difference of maturity weightings in the two indices. We can see that styles sectors contribute much more in the BCOM index. In particular Open Interest and Volatility factors are significantly different between the two indices.

For curves strategies it is therefore key to monitor exposures to these two factors. The factor model obviously allows users to easily compute the exposures but also quantify the risk impact of the curve strategy on the overall portfolio/pairs.