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INTRODUCING COMMODITY FACTOR INDICES

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New commodity indices apply factor strategies to a broad-based index

ICE Data Indices has recently launched two new commodity factor indices that apply their methodology to a base index of liquid, production-weighted futures contracts (MLCX03).

- ICE BofA Commodity Enhanced Carry Index (MLCX3CR): focuses on the carry factor, where weights of selected contracts are tilted towards those having a high positive carry
- ICE BofA Commodity Multi-Factor Index (MLCX3MF): takes the carry, momentum and value factors into consideration, where the weights of selected contracts are tilted towards those contracts having high positive carry, strong momentum scores and high value relative to their long term historical average prices

Factor indices have notably improved risk/return profile

Both factor indices significantly outperformed their broad, production-weighted base index over the last 17 years, and they managed to do so with lower volatility.

Low correlation to broad U.S. equities/bonds…

Low correlation to the broad equity and fixed-income asset classes is often what investors look for in their allocation to the commodity asset class. The commodity factor indices meet that criteria with roughly a 50% correlation to the ICE U.S. 3000 Index (broad U.S. listed equities), and with both almost perfectly uncorrelated to the investment grade ICE BofA US Broad Market Index (broad U.S. investment grade bonds).

…while boosting the efficient frontier

An efficient frontier analysis shows that, unlike the production-weighted base commodity index, an allocation to the factor indices can improve the risk/return profile of a multi-asset allocation strategy.

Introducing the ICE BofA commodity factor indices

Overview

New indices apply factor strategies to a broad-based commodity index.

ICE Data Indices has recently launched two new commodity factor indices that apply their methodology to a base index of liquid, production-weighted futures contracts ("MLCX03").

- The ICE BofA Commodity Enhanced Carry Index ("MLCX3CR") measures the performance of a long-only basket of liquid commodity futures contracts representing the underlying commodities with the largest global production value, where the weights of selected contracts are tilted towards those having a high positive carry.

- The ICE BofA Commodity Multi-Factor Index ("MLCX3MF") measures the performance of a long-only basket of liquid commodity futures contracts representing the underlying commodities with the largest global production value, where the weights of selected contracts are tilted towards those having high positive carry; strong momentum scores and high value relative to their respective long-term historical average contract prices.

Factor scores are updated and the indices are rebalanced monthly. Refer to Appendix A for complete details on construction methodology.

The factor indices have significantly outperformed the production-weighted base index over the last 17 years.

Over a 17-year back test, both factor indices significantly outperformed their broad, production-weighted base index, MLCX03 (Exhibit A), including at the height of the 2008 financial crisis period. Looking at the trailing 12-month total returns during the full back test (Exhibit B), the Enhanced Carry index outperformed the base index 82% of the time by an average of 6.97%. The maximum shortfall in any 12-month period was a little over 8%: in the 12-month period ending March 31, 2004 (-8.04%) and the 12-month period ending February 28, 2017 (-8.03%). The Multi-Factor index was even more consistent in its outperformance as it exceeded the base MLCX03 index in 89% of the 12-month observations, with an average 12-month excess return of 4.97%. The Multi-Factor index never underperformed by more than 5% in any 12-month period. In absolute terms, the worst period for the base index and both factor indices was the 12 months ending in February 2009. Here, the base MLCX03 index lost 47%, compared to 39% and 40% for the Enhanced Carry and Multi-Factor indices, respectively. The factor indices rebounded faster after the late-2008 through early 2009 sell-off with both fully reversing the maximum drawdown by early 2011. MLCX03 has yet to get back to its prior mid-2008 high.

Exhibit A: Commodity factor indices vs broad parent index

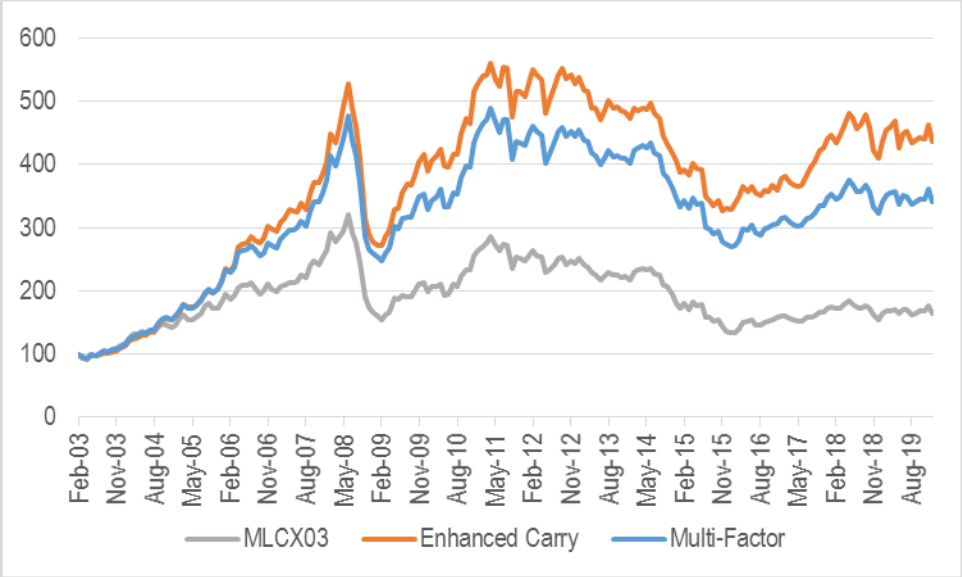
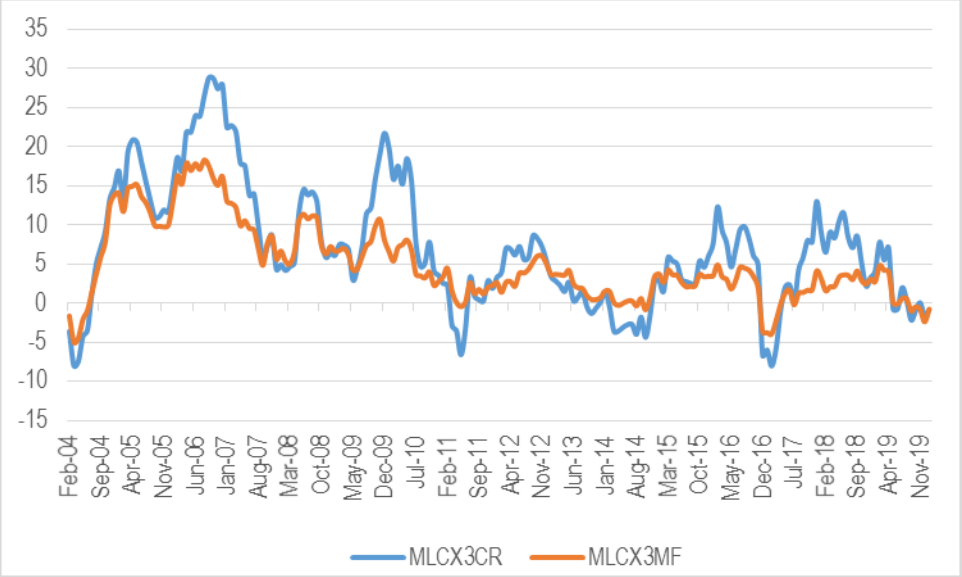


Exhibit B: 12-month factor index returns vs MLCX03



The factor indices achieved higher returns without increased volatility.

The factor indices managed to achieve significant outperformance versus the base index over the last 17 years with lower volatility (Exhibit C). The Multi-Factor index has the lowest standard deviation of returns of the three by a small margin, but the Enhanced Carry index has an annualized return that is 1.61% higher than the Multi-Factor Index and nearly three times that of the base MLCX03 index over the last 17 years. The resulting Sharpe ratio for Enhanced Carry represents a notable pick-up versus MLCX03 (0.16 vs 0.05), and the lower annualized standard deviation for the Multi-Factor means its Sharpe ratio is close (0.13).

Exhibit C: Commodity factor indices vs MLCX03 (March 2003 - January 2020)

	Cumulative Return	Std.Dev.	Annualized Return	Ann.Std.Dev	Sharpe Ratio
MLCX03	70.18	4.63	3.23	16.03	0.05
Enhanced Carry	348.26	4.57	9.37	15.83	0.16
Multi-Factor	249.56	4.45	7.76	15.43	0.13

Commodity factor indices and the efficient frontier

Inclusion of the commodity factor indices as available assets can boost the efficient frontier.

As an asset class, commodities have typically been included in portfolios as a part of an "alternatives" allocation, with the key goal being to enhance long-term risk-adjusted returns due, in large part, to a lack of correlation with traditional equity and fixed income investments. That can clearly be seen in the long-term correlation of the base MLCX03 index, as well as both the Enhanced Carry and Multi-Factor indices, to broad U.S. equity and U.S. investment grade bond indices (Exhibit D). All three commodity indices are roughly 50% correlated to the ICE U.S. 3000 Index (broad U.S. listed equities), and almost perfectly uncorrelated to the investment grade ICE BofA US Broad Market Index (broad U.S. investment grade bonds).

Exhibit D: Correlation of Commodity Factor Indices vs Equity and Fixed Income

Asset Class	Index	MLCX03	MLCX3CR	MLXC3MF	ICEUS3K	US00
Commodity	Commodity index eXtra 03 Total Return (MLCX03T)	1.00				
Commodity	Enhanced Carry Total Return (MLCX3CRT)	0.93	1.00			
Commodity	Multi-Factor Total Return (MLCX3MFT)	0.98	0.98	1.00		
Equity	ICE U.S. 3000 Total Return (ICEUS3KT)	0.49	0.50	0.49	1.00	
Fixed Income	ICE BofAML US Broad Market Index (US00)	-0.03	-0.01	-0.01	-0.02	1.00

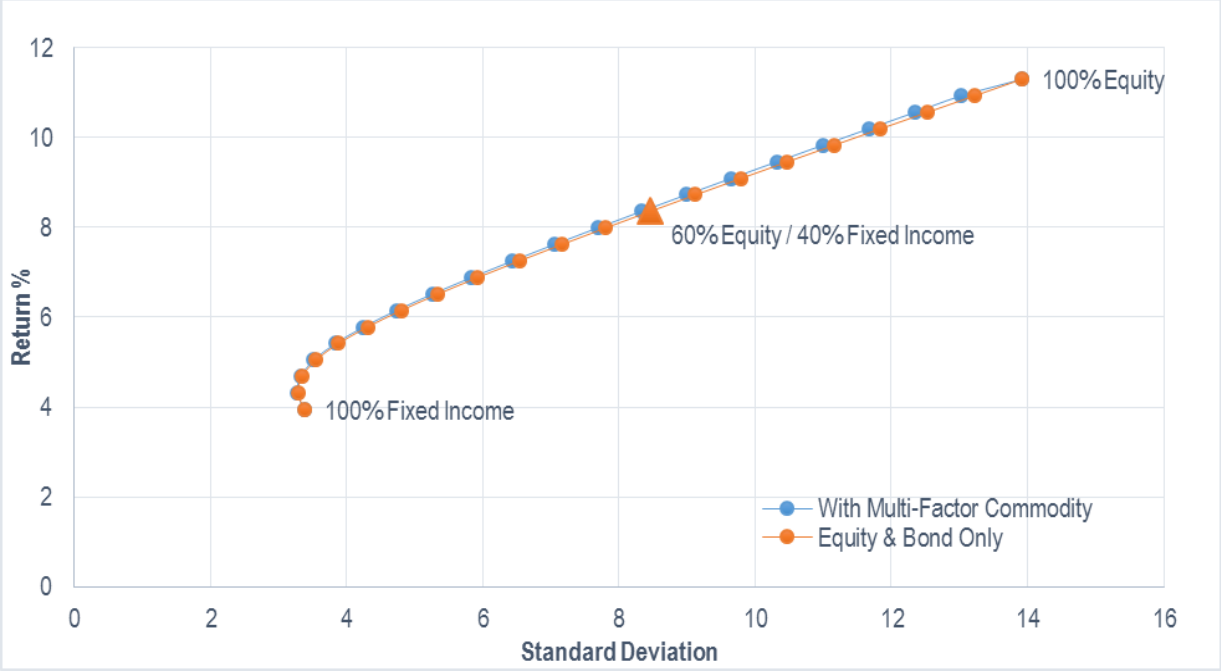
With the low correlation to bonds and equities, it is possible to pick up incremental return by allocating to commodities. However, the relatively high volatility of commodities may not make its risk-adjusted return attractive enough to reside on the efficient frontier of investable assets. In fact, inclusion of the base index (MLCX03) as an available asset along with equities and bonds has virtually no impact on the efficient frontier. However, the additional returns provided by the factor strategies incorporated into the Enhanced Carry and Multi-Factor commodity indices do improve the efficient frontier curve relative to a pure equity/fixed income allocation.

When the Enhanced Carry Index is introduced as an available asset alongside equities and bonds the optimal solution allocates as much as 20+% to commodities in the high risk scenarios, and 10.79% on average across all scenarios. Viewing the efficient frontier curve allowing for allocation to the Enhanced Carry Commodity Index versus a curve that only allocates to equities and bonds illustrates the desired impact of adding alternative assets to the traditional equity-bond portfolio allocation (Exhibit E). The entire curve is shifted to the left, reducing risk for the same return by an average of 0.18 across all points on the curve. For example, a 60%/40% equity-bond allocation produced an 8.54% annualized return, while a 14% allocation to the Enhanced carry index, along with a 49% allocation to equities and a 37% allocation to bonds, produced that same annualized return with a 0.24 lower annualized standard deviation (8.16 vs 8.40).

Exhibit E: US Equity-Bond Efficient Frontier with Enhanced Carry Commodity Index

Considered separately for possible inclusion in a traditional equity-bond blend, the Multi-Factor index also allows for an improvement in the efficient frontier, though the maximum allocation is just 4% and the corresponding impact on the resulting portfolio's risk-return profile is relatively modest. The resulting efficient frontier curve is predictably close to that of the equity/bond only curve, but still shows the distinctive slide to the left (Exhibit F).

Exhibit F: US Equity-Bond Efficient Frontier with Multi-Factor Commodity Index



Appendix A: Rules & Methodology

ICE BofA Commodity Enhanced Carry Total Return Index

General Description

The ICE BofA Commodity Enhanced Carry Total Return Index ("MLCX3CRT") measures the performance of a long-only basket of liquid commodity futures contracts representing the underlying commodities with the largest global production value, where the weights of selected contracts are tilted towards those contracts that have high positive carry. MLCX3CRT uses the ICE BofA Commodity Index eXtra 03 (MLCX03) as its starting point. The Soybean Meal and Soybean Oil contracts, if present in MLCX03, are excluded from MLCX3CRT and their weights are reallocated to the Soybean contract to arrive at the preliminary MLCX3CRT Contract weights. In addition, where MLCX03 replaces eligible non-Intercontinental Exchange ("ICE") contracts with comparable ICE contracts, MLCX3CRT does not. The MLCX3CRT weights are then adjusted to increase the allocation to the top 10 high-carry commodities and reduce the allocation to the remaining low-carry commodities.

MLCX3CRT generally uses the same selection, weighting and calculation methodologies that apply to the MLCX family of indices, but with certain modifications. Specifically, the modifications include a monthly rebalancing frequency, a different method for calculating Percentage Target Weights and a different contract Roll Schedule. In addition, Contract Production Weights are recalculated monthly. These modifications are explained in detail below. All other MLCX methodologies can be found in the ICE BofA Commodity Index eXtra Handbook (the "Handbook"), which is available on the ICE Index Platform (*https://indices.theice.com*) under the Rules & Methodologies tab of the Publications section.

Definitions

The **Contract Production Weights (CPWs)** are the weights of the relevant MLCX3CRT Contracts for purposes of calculating MLCX3CRT. The CPWs are recalculated every month according to the methodology described below.

The **Percentage Target Weights (PTWs)** are the weights of the relevant MLCX3CRT Contracts used to determine the Contract Production Weights for purposes of calculating MLCX3CRT.

The **MLCX3CRT Contracts** are the futures contracts included in MLCX3CRT.

The **Rebalancing Day** is the first day of the Roll Period.

The **Roll Period** is the period from the last Business Day of a calendar month to the fourth Business Day of the next month when MLCX3CRT rolls.

The **Weight Calculation Day** is the Business Day prior to the start of the Roll Period.

Rolling Mechanism

The rolling mechanism is similar to that described in Chapter 3 of the Handbook; however, MLCX3CRT uses a distinct five-day Roll Period rather than the 15-day Roll Period used for MLCX. The MLCX3CRT Roll Period runs from the last Business Day of the month to the fourth Business Day of the next month. The MLCX3CRT Contracts are rolled from the contract listed in Table 1 for the current month to the contract listed for the following month.

Table 1: Underlying Contract Table (contracts held in MLCX3CRT at the beginning of each month)

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aluminium	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Brent	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Cocoa	K	K	N	N	U	U	Z	Z	Z	H+	H+	H+
Coffee	N	N	Z	Z	Z	H+	H+	H+	H+	K+	K+	K+
Copper	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Corn	Z	Z	Z	Z	Z	H+	H+	H+	Z+	Z+	Z+	Z+
Cotton	N	Z	Z	Z	Z	Z	Z	Z	H+	H+	N+	N+
Crude Oil (WTI)	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Gasoil	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Gasoline (RBOB)	M	M	M	Z	Z	Z	Z	Z	Z	M+	M+	M+
Gold	M	M	Q	Q	Z	Z	Z	Z	G+	G+	J+	J+
Heating Oil	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Lean Hogs	M	N	Q	V	V	V	Z	Z	G+	G+	M+	M+
Live Cattle	M	M	V	V	V	Z	Z	J+	J+	J+	M+	M+
Natural Gas	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Nickel	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Silver	K	N	N	U	U	Z	Z	Z	H+	H+	H+	K+
Soybean	X	X	X	X	X	X	F+	F+	X+	X+	X+	X+
Sugar	H+	H+	H+	H+	H+	N+	N+	N+	V+	V+	V+	V+
Wheat	Z	Z	Z	Z	Z	Z	Z	N+	N+	N+	N+	N+
Wheat (Kansas)	Z	Z	Z	Z	Z	Z	Z	N+	N+	N+	N+	N+
Zinc	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+

Month Letter Code: January F, February G, March H, April J, May K, June M, July N, August Q, September U, October V, November X and December Z. A "+" following the letter indicates a contract of the following year.

Annualized Basis Calculation

The Annualized Basis for commodity *i* on day *t* is defined as:

$$B_{i,t} = \left(\frac{F_{0i,t}}{F_{1i,t}} - 1\right) \times \left(\frac{365}{D_{1i,t} - D_{0i,t}}\right)$$

Here, $F_{0i,t}$ and $D_{0i,t}$ are the price and time to last trade date, respectively, as of date *t* of the contract for a short position in commodity *i* (Table 2) for the month immediately following the month at *t*. $F_{1i,t}$ and $D_{1i,t}$ are the price and time to last trade date, respectively, as of date *t* of the contract for a long position in commodity *i* (Table 3) for the month immediately following the month at *t*. The Annualized Basis is calculated on the Weight Calculation Day.

Table 2: Basis short contracts

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aluminium	H	H	K	K	N	N	U	U	X	X	F+	F+
Brent	H	K	K	N	N	U	U	X	X	F+	F+	H+
Cocoa	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Coffee	H	H	K	K	N	N	U	U	Z	Z	Z	H+

Table 2: Basis short contracts

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Copper	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Corn	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Cotton	H	H	K	K	N	N	Z	Z	Z	Z	Z	H+
Crude Oil (WTI)	H	H	K	K	N	N	U	U	X	X	F+	F+
Gasoil	G	H	J	K	M	N	Q	U	V	X	Z	F+
Gasoline (RBOB)	H	H	K	K	N	N	U	U	X	X	F+	F+
Gold	G	J	J	M	M	Q	Q	Z	Z	Z	Z	G+
Heating Oil	H	H	K	K	N	N	U	U	X	X	F+	F+
Lean Hogs	G	J	J	M	M	N	Q	V	V	Z	Z	G+
Live Cattle	G	J	J	M	M	Q	Q	V	V	Z	Z	G+
Natural Gas	H	H	K	K	N	N	U	U	X	X	F+	F+
Nickel	H	H	K	K	N	N	U	U	X	X	F+	F+
Silver	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Soybean	H	H	K	K	N	N	X	X	X	X	F+	F+
Sugar	H	H	K	K	N	N	V	V	V	H+	H+	H+
Wheat	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Wheat (Kansas)	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Zinc	H	H	K	K	N	N	U	U	X	X	F+	F+

Table 3: Basis long contracts

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aluminium	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Brent	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Cocoa	K	K	N	N	U	U	Z	Z	H+	H+	H+	K+
Coffee	K	N	N	Z	Z	Z	H+	H+	H+	H+	K+	K+
Copper	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+	Z+
Corn	Z	Z	Z	Z	Z	Z	H+	H+	H+	Z+	Z+	Z+
Cotton	N	N	Z	Z	Z	Z	H+	H+	H+	H+	H+	N+
Crude Oil (WTI)	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Gasoil	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Gasoline (RBOB)	M	M	M	M	Z	Z	Z	Z	Z	Z	M+	M+
Gold	J	M	M	Q	Q	Z	Z	G+	G+	G+	G+	J+
Heating Oil	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Lean Hogs	M	M	N	Q	V	V	V	Z	Z	G+	G+	M+
Live Cattle	M	M	M	V	V	V	Z	Z	J+	J+	J+	M+
Natural Gas	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Nickel	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Silver	K	K	N	N	U	U	Z	Z	H+	H+	H+	K+
Soybean	X	X	X	X	X	X	F+	F+	F+	X+	X+	X+
Sugar	V	H+	H+	H+	H+	H+	N+	N+	N+	V+	V+	V+
Wheat	N	Z	Z	Z	Z	Z	Z	Z	N+	N+	N+	N+
Wheat (Kansas)	N	Z	Z	Z	Z	Z	Z	Z	N+	N+	N+	N+
Zinc	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+

Benchmark Weight

The Benchmark Weight (BW) of commodity *i* on Weight Calculation Day *t* is equal to the Target Weight of each corresponding MLCX03 Contract with the exception that the Soybean Meal and Soybean Oil contracts, if present in MLCX03, are excluded from MLCX3CRT and their Target Weights are reallocated to the Soybean contract. In addition, where MLCX03 replaces eligible non-Intercontinental Exchange ("ICE") contracts with comparable ICE contracts, MLCX3CRT does not.

Selection Weight

The Selection Weight (SW) of a commodity *i* on Weight Calculation Day *t* is computed as:

$$SW_{i,t} = \begin{cases} BW_{i,t} \text{ if } Rank\_Descending(B_{i,t}) \leq 10 \text{ and } BW_{i,t} > 0 \\ 0 \quad \text{otherwise} \end{cases}$$

where *Rank_Descending($B_{i,t}$)* is the rank of all commodities in MLCX3CRT with a positive Benchmark Weight arranged in the *decreasing* order based on Annualized Basis $B_{i,t}$. As a result, the Selection Weight for commodity *i* is positive if it is in the top-10 most backwardated commodities.

Percentage Target Weight

The Percentage Target Weight (PTW) of commodity *i* for roll month *j* is computed as:

$$PTW_{i,j} = \frac{SW_{i,R-1}}{\sum_{i=1}^{n} SW_{i,R-1}}$$

where *R* is the Rebalancing Day for month *j* and *R-1* is the Weight Calculation Day corresponding to *R*.

Contract Production Weight

According to Section 3.3 of the Handbook, we calculate the MLCX3CRT Total Dollar Weights (TDW) on the Weight Calculation Day of month j. Based on this TDW, the Contract Production Weight (CPW) for commodity *i* on month *j* is calculated according to the formula:

$$CPW_{ij} = \frac{TDW \times PTW_{ij}}{P_{ij}}$$

where P_{ij} denotes the price of the MLCX3CRT contract for commodity *i*, on the Weight Calculation Day for month *j*.

ICE BofA Commodity Multi-Factor Total Return Index

General Description

The ICE BofA Commodity Multi-Factor Total Return Index ("MLCX3MFT") measures the performance of a long-only basket of liquid commodity futures contracts representing the underlying commodities with the largest global production value, where the weights of selected contracts are tilted towards those contracts that have high positive carry, strong momentum scores and high value relative to their respective long term historical average contract prices. MLCX3MFT uses the ICE BofA Commodity Index eXtra 03 (MLCX03) as its starting point. The Soybean Meal and Soybean Oil contracts, if present in MLCX03, are excluded from MLCX3MFT and their weights are reallocated to the Soybean contract to arrive at the preliminary MLCX3MFT Contract weights. In addition, where MLCX03 replaces eligible non-Intercontinental Exchange ("ICE") contracts with comparable ICE contracts, MLCX3MFT does not. The MLCX3MFT weights are then adjusted to reflect the carry, momentum and value factors.

MLCX3MFT generally uses the same selection, weighting and calculation methodologies that apply to the MLCX family of indices, but with certain modifications. Specifically, the modifications include a monthly rebalancing frequency, a different method for calculating Percentage Target Weights and a different contract Roll Schedule. In addition, Contract Production Weights are recalculated monthly. These modifications are explained in detail below. All other MLCX methodologies can be found in the ICE BofA Commodity Index eXtra Handbook (the "Handbook"), which is available on the ICE Index Platform (*https://indices.theice.com*) under the Rules & Methodologies tab of the Publications section.

Definitions

The **Contract Production Weights (CPWs)** are the weights of the relevant MLCX3MFT Contracts for purposes of calculating MLCX3MFT. The CPWs are recalculated every month according to the methodology described below.

The **Percentage Target Weights (PTWs)** are the weights of the relevant MLCX3MFT Contracts used to determine the Contract Production Weights for purposes of calculating MLCX3MFT.

The **MLCX3MFT Contracts** are the futures contracts included in MLCX3MFT.

The **Rebalancing Day** is the first day of the Roll Period.

The **Roll Period** is the period from the last Business Day of a calendar month to the fourth Business Day of the next month when MLCX3MFT rolls.

The **Weight Calculation Day** is the Business Day prior to the start of the Roll Period.

Rolling Mechanism

The rolling mechanism is similar to that described in Chapter 3 of the Handbook; however, MLCX3MFT uses a distinct five-day Roll Period rather than the 15-day Roll Period used for MLCX. The MLCX3MFT Roll Period runs from the last Business Day of the month to the fourth Business Day of the next month. The MLCX3MFT Contracts are rolled from the contract listed in Table 1 for the current month to the contract listed for the following month.

Table 1: Underlying Contract Table (contracts held in MLCX3MFT at the beginning of each month)

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aluminium	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Brent	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Cocoa	K	K	N	N	U	U	Z	Z	Z	H+	H+	H+
Coffee	N	N	Z	Z	Z	H+	H+	H+	H+	K+	K+	K+
Copper	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Corn	Z	Z	Z	Z	Z	H+	H+	H+	Z+	Z+	Z+	Z+
Cotton	N	Z	Z	Z	Z	Z	Z	Z	H+	H+	N+	N+
Crude Oil (WTI)	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Gasoil	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Gasoline (RBOB)	M	M	M	Z	Z	Z	Z	Z	Z	M+	M+	M+
Gold	M	M	Q	Q	Z	Z	Z	Z	G+	G+	J+	J+
Heating Oil	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Lean Hogs	M	N	Q	V	V	V	Z	Z	G+	G+	M+	M+
Live Cattle	M	M	V	V	V	Z	Z	J+	J+	J+	M+	M+
Natural Gas	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Nickel	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+
Silver	K	N	N	U	U	Z	Z	Z	H+	H+	H+	K+
Soybean	X	X	X	X	X	X	F+	F+	X+	X+	X+	X+
Sugar	H+	H+	H+	H+	H+	N+	N+	N+	V+	V+	V+	V+
Wheat	Z	Z	Z	Z	Z	Z	Z	N+	N+	N+	N+	N+
Wheat (Kansas)	Z	Z	Z	Z	Z	Z	Z	N+	N+	N+	N+	N+
Zinc	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+

Month Letter Code: January F, February G, March H, April J, May K, June M, July N, August Q, September U, October V, November X and December Z. A "+" following the letter indicates a contract of the following year.

Commodity Pricing References

Commodity Pricing References are the official settlement prices for the contract month specified in the Commodity Pricing Reference roll schedule for each commodity in MLCX3MFT (Table 2). All the Commodity Pricing References roll from the fifth to the ninth Business Day of each month. The rolling mechanism is similar to that described in Chapter 3 of the Handbook.

Table 2: Roll schedules of Commodity Pricing References

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aluminium	H	H	K	K	N	N	U	U	X	X	F+	F+
Brent	H	K	K	N	N	U	U	X	X	F+	F+	H+
Cocoa	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Coffee	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Copper	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Corn	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Cotton	H	H	K	K	N	N	Z	Z	Z	Z	Z	H+
Crude Oil (WTI)	H	H	K	K	N	N	U	U	X	X	F+	F+
Gasoil	G	H	J	K	M	N	Q	U	V	X	Z	F+
Gasoline (RBOB)	H	H	K	K	N	N	U	U	X	X	F+	F+
Gold	G	J	J	M	M	Q	Q	Z	Z	Z	Z	G+
Heating Oil	H	H	K	K	N	N	U	U	X	X	F+	F+
Lean Hogs	G	J	J	M	M	N	Q	V	V	Z	Z	G+
Live Cattle	G	J	J	M	M	Q	Q	V	V	Z	Z	G+
Natural Gas	H	H	K	K	N	N	U	U	X	X	F+	F+
Nickel	H	H	K	K	N	N	U	U	X	X	F+	F+
Silver	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Soybean	H	H	K	K	N	N	X	X	X	X	F+	F+

Table 2: Roll schedules of Commodity Pricing References

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sugar	H	H	K	K	N	N	V	V	V	H+	H+	H+
Wheat	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Wheat (Kansas)	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Zinc	H	H	K	K	N	N	U	U	X	X	F+	F+

Weights

The computation of Percentage Target Weights (PTW_i,R) involves calculating intermediate weights for three different factors: Carry, Value and Momentum. Each of these is described in detail below. The starting point is the Benchmark Weight (BW) of each commodity *i* on Weight Calculation Day *t*, which is equal to the Target Weight of each corresponding MLCX03 Contract with the exception that the Soybean Meal and Soybean Oil contracts, if present in MLCX03, are excluded from MLCX3MFT and their Target Weights are reallocated to the Soybean contract. In addition, where MLCX03 replaces eligible non-Intercontinental Exchange ("ICE") contracts with comparable ICE contracts, MLCX3MFT does not.

1 Carry Factor

1.1 Annualized Basis

The Annualized Basis for commodity *i* on day *t* is defined as:

$$\boldsymbol{B_{i,t}} = \left(\frac{\boldsymbol{F_{0i,t}}}{\boldsymbol{F_{1i,t}}} - \mathbf{1}\right) \times \left(\frac{\mathbf{365}}{\boldsymbol{D_{1i,t}} - \boldsymbol{D_{0i,t}}}\right)$$

Here, $F_{0i,t}$ and $D_{0i,t}$ are the price and time to last trade date, respectively, as of date *t* of the contract for a short position in commodity *i* (Table 3) for the month immediately following the month *t*. $F_{1i,t}$ and $D_{1i,t}$ are the price and time to last trade date, respectively, as of date *t* of the contract for a long position in commodity *i* (Table 4) for the month immediately following the month at *t*. The Annualized Basis is calculated on the Weight Calculation Day.

Table 3: Basis short contracts

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aluminium	H	H	K	K	N	N	U	U	X	X	F+	F+
Brent	H	K	K	N	N	U	U	X	X	F+	F+	H+
Cocoa	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Coffee	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Copper	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Corn	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Cotton	H	H	K	K	N	N	Z	Z	Z	Z	Z	H+
Crude Oil (WTI)	H	H	K	K	N	N	U	U	X	X	F+	F+
Gasoil	G	H	J	K	M	N	Q	U	V	X	Z	F+
Gasoline (RBOB)	H	H	K	K	N	N	U	U	X	X	F+	F+
Gold	G	J	J	M	M	Q	Q	Z	Z	Z	Z	G+
Heating Oil	H	H	K	K	N	N	U	U	X	X	F+	F+
Lean Hogs	G	J	J	M	M	N	Q	V	V	Z	Z	G+
Live Cattle	G	J	J	M	M	Q	Q	V	V	Z	Z	G+
Natural Gas	H	H	K	K	N	N	U	U	X	X	F+	F+
Nickel	H	H	K	K	N	N	U	U	X	X	F+	F+
Silver	H	H	K	K	N	N	U	U	Z	Z	Z	H+

Table 3: Basis short contracts

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Soybean	H	H	K	K	N	N	X	X	X	X	F+	F+
Sugar	H	H	K	K	N	N	V	V	V	H+	H+	H+
Wheat	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Wheat (Kansas)	H	H	K	K	N	N	U	U	Z	Z	Z	H+
Zinc	H	H	K	K	N	N	U	U	X	X	F+	F+

Table 4: Basis long contracts

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aluminium	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Brent	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Cocoa	K	K	N	N	U	U	Z	Z	H+	H+	H+	K+
Coffee	K	N	N	Z	Z	Z	H+	H+	H+	H+	K+	K+
Copper	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+	Z+	Z+
Corn	Z	Z	Z	Z	Z	Z	H+	H+	H+	Z+	Z+	Z+
Cotton	N	N	Z	Z	Z	Z	H+	H+	H+	H+	H+	N+
Crude Oil (WTI)	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Gasoil	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Gasoline (RBOB)	M	M	M	M	Z	Z	Z	Z	Z	Z	M+	M+
Gold	J	M	M	Q	Q	Z	Z	G+	G+	G+	G+	J+
Heating Oil	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Lean Hogs	M	M	N	Q	V	V	V	Z	Z	G+	G+	M+
Live Cattle	M	M	M	V	V	V	Z	Z	J+	J+	J+	M+
Natural Gas	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Nickel	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+
Silver	K	K	N	N	U	U	Z	Z	H+	H+	H+	K+
Soybean	X	X	X	X	X	X	F+	F+	F+	X+	X+	X+
Sugar	V	H+	H+	H+	H+	H+	N+	N+	N+	V+	V+	V+
Wheat	N	Z	Z	Z	Z	Z	Z	Z	N+	N+	N+	N+
Wheat (Kansas)	N	Z	Z	Z	Z	Z	Z	Z	N+	N+	N+	N+
Zinc	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z+	Z+

1.2 Selection Weights

The Selection Weight (SW) of a commodity *i* on Weight Calculation Day *t* is computed as:

$$\boldsymbol{SW_{i,t}} = \begin{cases} \boldsymbol{BW_{i,t}} \text{ if } Rank\_Descending(\boldsymbol{B_{i,t}}) \leq \mathbf{10} \textbf{ and } \boldsymbol{BW_{i,t}} > \mathbf{0} \\ \mathbf{0} \qquad \text{otherwise} \end{cases}$$

where *Rank_Descending($B_{i,t}$)* is the rank of *i* among all commodities in MLCX3MFT with a positive Benchmark Weight arranged in the *decreasing* order based on Annualized Basis $B_{i,t}$. As a result, the Selection Weight for commodity *i* is positive if it is in the top-10 most backwardated commodities.

1.3 Carry Factor Weights

The Carry Factor Weight (CFW) of commodity *i* for roll month *j* is computed as:

$$\boldsymbol{CFW_{i,j}} = \frac{\boldsymbol{SW_{i,R-1}}}{\sum_{i=1}^{n} \boldsymbol{SW_{i,R-1}}}$$

where *R* is the Rebalancing Day for month *j, n* is the total number of MLCX3MFT Contracts and *R-1* is the Weight Calculation Day corresponding to *R*.

2 Momentum Factor

2.1 Momentum Signal

On Business Day *t*, for Commodity Pricing Reference $\boldsymbol{PR_i}$ as described above, we define the Slope of the regression of Commodity Pricing Reference levels against time over the preceding *d* Business Days as follows:

$$\boldsymbol{Slope_{i,d}(t)} = -\frac{\boldsymbol{d}\sum_{m=1}^{d}\boldsymbol{m}\times\boldsymbol{PR_i(t+1-m)} - \sum_{m=1}^{d}\boldsymbol{m}\times\sum_{m=1}^{d}\boldsymbol{PR_i(t+1-m)}}{\boldsymbol{d}\sum_{m=1}^{d}\boldsymbol{m^2} - \left(\sum_{m=1}^{d}\boldsymbol{m}\right)^2}$$

where $\boldsymbol{PR_i(t)}$ is the level of $\boldsymbol{PR_i}$ on Business Day *t* and *t+1-m* is a day which is *m+1* Business Days before *t*.

We define the Regression Window Vector (*RWV*) as follows:

$\boldsymbol{RWV} = [\mathbf{1},\mathbf{2},\mathbf{3},\mathbf{4},\mathbf{5},\mathbf{6},\mathbf{7},\mathbf{8},\mathbf{9},\mathbf{10},\mathbf{11},\mathbf{12}] \times \mathbf{21}$ = [21, 42, 63, 84, 105, 126, 147, 168, 189, 210, 231, 252]

For $\boldsymbol{PR_i}$, on Business Day *t*, we define the signal as follows:

$$\boldsymbol{Signal_{i,t}} = \begin{cases} \mathbf{1} & \textbf{If } \boldsymbol{Slope_{i,d}(t)} > \mathbf{0} \textbf{ for all } \boldsymbol{d} \textbf{ included in } \boldsymbol{RWV} \\ \mathbf{-1} & \textbf{If } \boldsymbol{Slope_{i,d}(t)} < \mathbf{0} \textbf{ for all } \boldsymbol{d} \textbf{ included in } \boldsymbol{RWV} \\ \mathbf{0} & \textbf{Otherwise} \end{cases}$$

2.2 Momentum Factor Weights

The Outperformance Momentum Weights (OMW) are first calculated as:

$$\boldsymbol{OMW_{i,t}} = \boldsymbol{Signal_{i,t}} \times \mathbf{0.5} \times \boldsymbol{BW_{i,t}}$$

The Total Outperformance Momentum Weights (TOMW) are then calculated as:

$$\boldsymbol{TOMW_t} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \boldsymbol{OMW_{i,t}}$$

The Outperformance Ratios (OR) are then calculated as:

$$\boldsymbol{OR_t} = \frac{\boldsymbol{Max}(\boldsymbol{Min}(\boldsymbol{TOMW_t}, \mathbf{20}\%), -\mathbf{20}\%)}{\boldsymbol{TOMW_t}}$$

The Momentum Factor Weight (MFW) of the commodity *i* for roll month j is computed as:

$$MFW_{i,j} = BW_{i,SD(R)} + \boldsymbol{OR_{SD(R)}} \times \boldsymbol{OMW_{i,SD(R)}}$$

where SD(R) is one Business Day prior to the last Wednesday on or before R.

3 Value Factor

To calculate the Value Factor Weights (VFW), commodities are grouped into sectors as defined below:

Table 5: Commodity Sectors	
Sector S_i	**Commodity *i***
Petroleum	Brent
	Crude Oil (WTI)
	Gasoline
	Gasoil
	Heating Oil
Base Metals	Copper
	Aluminium
	Nickel
	Zinc
Precious Metals	Gold
	Silver
Grains & Oilseeds	Corn
	Soybeans
	Wheat
	Wheat (Kansas)
Softs	Sugar
	Cocoa
	Cotton
	Coffee
Livestock	Live Cattle
	Lean Hogs
Natural Gas	Natural Gas

3.1 Valuation Measure

The Valuation Measure (VM) for commodity *i* on day *t* is defined as:

$$\boldsymbol{VM_{i,t}} = -\frac{\frac{\mathbf{1}}{\mathbf{66}}\sum_{\boldsymbol{u=t-65}}^{\boldsymbol{t}} \boldsymbol{C_{i,u}^{(SP)}}}{\frac{\mathbf{1}}{\mathbf{1260}}\sum_{\boldsymbol{u=t-1259}}^{\boldsymbol{t}} \boldsymbol{C_{i,u}^{(SP)}}}$$

where $C_{i,u}^{(SP)}$ represents the spot value of the Commodity Pricing Reference corresponding to commodity *i* on day *t* (as detailed above) on Business Day *u.* To clarify, this expression represents how undervalued/overvalued the short term spot value (average over the last 66 Business Days) is relative to the long term spot value (average over the last 1260 Business Days).

3.2 Cross-Sectional Z-Score

A Cross-Sectional Z-Score (Z) for commodity *i* on day *t* is defined as:

$$\boldsymbol{Z_{i,t}} = \frac{\boldsymbol{VM_{i,t}} - \mathbf{Median}_{\boldsymbol{S_i}}(\boldsymbol{VM_{i,t}})}{\mathbf{Stdev}_{\boldsymbol{S_i}}(\boldsymbol{VM_{i,t}})}$$

where $\mathrm{Median}_{S_i}(VM_{i,t})$ is the median of $VM_{i,t}$ across all the commodities in sector S_i.

3.3 Tilt Factor

The Value Tilt Factor for commodity *i* on day *t* is defined as:

$$\boldsymbol{TiltFactor}_{i,t}^{(\boldsymbol{Value})} = \begin{cases} \mathbf{1} + \mathbf{3} \times Z_{i,t} & \text{if } Z_{i,t} \geq 0 \\ \dfrac{\mathbf{1}}{\mathbf{1} - \mathbf{3} \times Z_{i,t}} & \text{otherwise} \end{cases}$$

3.4 Value Factor Weights

The Intermediate Value Weights (IVW) are first calculated as:

$$\boldsymbol{IVW}_{i,t} = \boldsymbol{TiltFactor}_{i,t}^{(\boldsymbol{Value})} \times \boldsymbol{BW}_{i,t}$$

where $\boldsymbol{BW}_{i,t}$ is the Benchmark Weight of a commodity as detailed above. The Value Factor Weight of the commodity *i* for roll month *j* is computed as:

$$\boldsymbol{VFW}_{i,j} = IVW_{i,R-1} \times \frac{\sum_{i \in S_i} \boldsymbol{BW}_{i,R-1}}{\sum_{i \in S_i} \boldsymbol{IVW}_{i,R-1}}$$

4 Percentage Target Weights

The Net Momentum Weight (NMW) for roll month *j* is defined as:

$$\boldsymbol{NMW}_j = \sum_i \boldsymbol{MFW}_{i,j} - \mathbf{1}$$

The Percentage Target Weight of a commodity *i* in roll month *j* is defined as:

$$\boldsymbol{PTW}_{i,j} = \frac{\mathbf{1}}{\mathbf{3}} \times \left\{ \boldsymbol{CFW}_{i,j} \times \left(\mathbf{1} - \frac{NMW_j}{\mathbf{2}} \right) + \boldsymbol{VFW}_{i,j} \times \left(\mathbf{1} - \frac{NMW_j}{\mathbf{2}} \right) + \boldsymbol{MFW}_{i,j} \right\}$$

5 Contract Production Weights

According to Section 3.3 of the Handbook, we calculate the MLCX3MFT Total Dollar Weights (TDW) on the Weight Calculation Day of month *j*. Based on this TDW, the Contract Production Weight (CPW) for commodity *i* in month *j* is calculated according to the formula:

$$\boldsymbol{CPW}_{i,j} = \frac{\boldsymbol{TDW} \times \boldsymbol{PTW}_{i,j}}{\boldsymbol{P}_{i,j}}$$

where $P_{i,j}$ denotes the price of the MLCX3MFT Contract for commodity *i* on the Weight Calculation Day for month *j*.

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