Commodity Portfolio Monthly

Adding value to commodity value

Bank of America Merrill Lynch

03 November 2017

Value strategies in commodities show good performance

Systematic value investing is popular in equities, but not so much in commodities. This is partly due to the difficulty in finding good value metrics and partly because risk-adjusted returns are not as high as in other systematic strategies like congestion or carry. However, we believe commodity value strategies are well worth looking into for two reasons. First, even relatively simple, no frills systematic value strategies in commodities have historically outperformed basic value strategies in equities and other asset classes on a risk-adjusted return basis as measured by info ratios (see Chart 1). Second, a mix of commodity value strategies can materially increase risk-adjusted returns of a basket of commodity risk premia strategies due to negative correlations. We previously wrote about a simple price-based commodity value strategy (see Spot price mean reversion) and now extend our work to introduce two innovative systematic value approaches.

Commodity curves are mean-reverting & can signal value

First, we suggest that the shape of a commodity curve can serve as an indicator of whether a commodity is expensive or cheap relative to its true fundamental value (i.e. its long-run cost of production). Timespreads, in contrast to price levels, can be mean-reverting and typically have more stable distributions over time. So our proposed curve value strategy stays short backwardated commodities and long contangoed ones. Yet this strategy suffers from negative carry returns while it waits for the curves to mean revert to fundamental value, so we adopt a longer holding period to allow mean reversion to play out to seek to offset the negative carry. This new curve value strategy concept is similar, and yet opposite, to our curve momentum strategies, with the key difference being in the holding period. Over a short 1-month holding period, curve shapes tend to be sticky and curve momentum can do well. Over longer a longer holding period of 3-months, curves tend to mean revert and value can do well. So, curve value and curve momentum complement each other well, in our view.

Alternatively, substitution effects also create mean-reversion

Second, we look at cross-commodity spreads that have large and fast substitution effects on either the supply or the demand side. For instance, the energy space is ripe with mean reverting spreads such as gasoline vs. diesel spreads. To build a strategy, we identify 30 spread candidates and find that 14 of these are mean reverting more than 70% of the time. According to our back testing analysis suggests that, the more stable the mean reverting relationship is, the better the spread trading strategy tends to perform (from Jan-2001 to Sep-2017). So we then combine these 14 stable spread trading strategies into an equally weighted basket, and find that the information ratio of our basket increases to 1.0 helped by diversification benefits inherent to commodity markets. In turn, our back tested strategy shows that combining our three value strategies (intra-sector price, intra-sector curve and spread) reduces drawdowns due to negative correlations, and enhances the information ratio of a commodity risk premia basket (see Chart 23 and Chart 24).

Commodities
Global

Global Commodity Research
MLPF&S

Peter Helles
Commodity Strategist
MLI (UK)
+44 20 7996 8154
peter.helles@baml.com

KeyYong Park
Derivatives Strategist
MLPF&S
+1 646 855 4765
keyyong.park@baml.com

Francisco Blanch
Commodity & Deriv Strategist
MLPF&S
+1 646 855 6212
francisco.blanch@baml.com

Abhinandan Deb >>
Equity-Linked Analyst
MLI (UK)
+44 20 7995 7148
abhinandan.deb@baml.com

Michael Widmer
Metals Strategist
MLI (UK)
+44 20 7996 0694
michael.widmer@baml.com

Sabine Schels
Commodity Strategist
MLI (UK)
+44 20 7995 7095
sabine.schels@baml.com

>> Employed by a non-US affiliate of MLPF&S and is not registered/qualified as a research analyst under the FINRA rules.

Refer to important disclosures on page 20 to 21.

11806931

Timestamp: 03 November 2017 04:36PM EDT

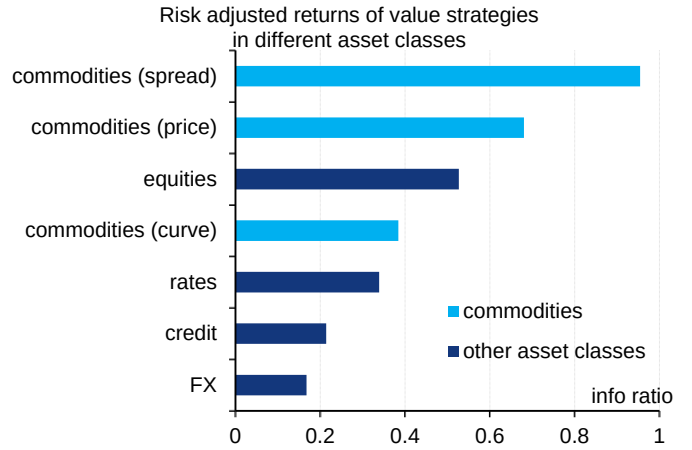
Adding value to commodity value

Value strategies popular in equities, yet returns can be good in commodities too

Systematic value investing is immensely popular in equities, and its popularity has only grown in in recent years with the advent of "smart beta". Less common are value strategies in commodities. This is partly due to the difficulty in finding good value metrics, and partly because risk-adjusted returns are not typically as high as in other systematic commodity strategies like carry or congestion. That said, we think commodity value strategies are well worth looking into for cross asset and commodity risk premia investors. First, our back tested analysis shows that even a relatively simple no frills systematic price-based value strategy in commodities historically has outperformed value strategies in equities and other asset classes (Chart 1). Second, a mix of value strategies can materially increase risk-adjusted returns of a basket of commodity risk premium strategies (Chart 2).

Disclaimer: The value (spread) and value (curve) strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

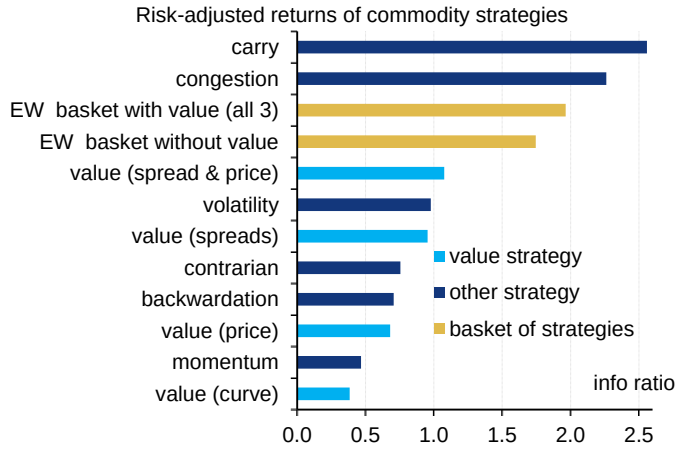
Chart 1: Value strategies in commodities have generally outperformed value strategies in equities and other asset classes



Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Based on daily returns from Jan-2004 to Sep-2017, chosen for longest common sample period. Note: The value (spread) and value (curve) strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Chart 2: Risk-adjusted value returns are not as high as in other systematic strategies, yet they complement other strategies well



Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Based on daily returns from Jan-2004 to Sep-2017, chosen for longest common sample period. Note: The value (spread) and value (curve) strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Commodity value: simple in theory but hard in practice due to lack of metrics

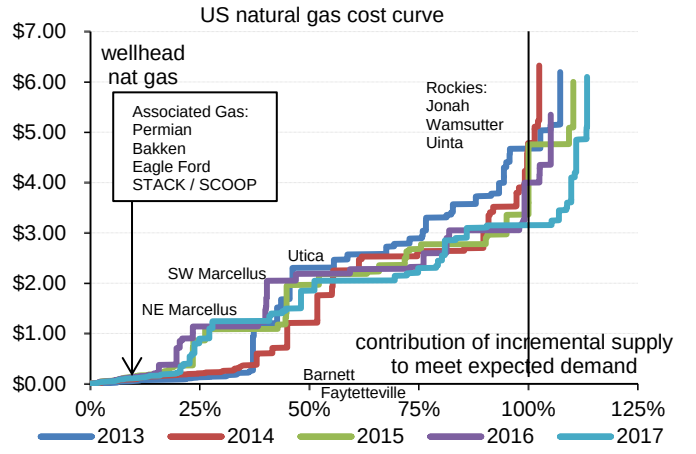
The concept of systematic value investing is simple: find a value metric to use as an estimator of fundamental value, and then buy assets that are cheap and sell those that are expensive relative to estimated fundamental value. Yet, this is a complicated task in commodities due to a lack of good value metrics available. In equities, balance sheet and

income data such as earnings and book value are popular value metrics that can be used to systematically estimate fundamental value, and these can be obtained from company accounts going back 100+ years. Similarly, in commodities, we could use cost curves to determine whether the current price of a commodity is expensive or cheap (Chart 3), yet for most commodities we do not have reliable cost curve data going back more than a few years. So there is hardly enough data to back test any systematic strategy using cost curves as a value metric.

The simplest measure of value is past prices or returns, rather than costs

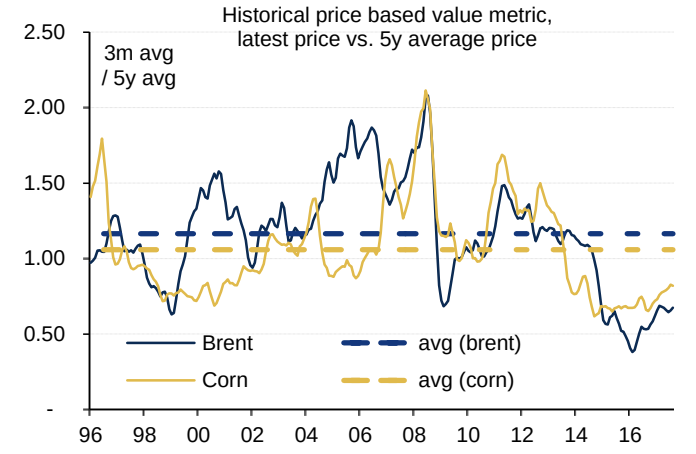
In response to the lack of good value metrics, researchers often simply use the average historical price as an estimate of each commodity's own fundamental value[1]. This method has the advantage of being very simple and easy to apply consistently across asset classes. It has one major drawback, though. Fundamental values are not constant over time, so historical prices are not necessarily a good indicator of present fundamental value. Permanent supply and demand shocks – due to technological advancements in production methods or new uses on the demand side – occur all the time that permanently shift the long-term equilibrium price, or fundamental value, to a new level. And so it is not clear that commodities will mean revert to any historical price level, even in real terms (ie, inflation adjusted) (Chart 4).

Chart 3: We can use cost curves to determine whether the current price of a commodity is expensive or cheap, but it is complicated



Source: BofA Merrill Lynch Global Research estimates

Chart 4: Even then, it is not clear that commodities will mean revert to any price level, even in real terms



Source: Bloomberg, BofA Merrill Lynch Global Research

Past prices/returns doesn't work if applied across all commodities

To test the robustness of these historical price value metrics we construct simple model portfolios that use two popular measures of fundamental value metrics based on historical prices:

1. Value metric 1: Average price over entire look back period

2. Value metric 2: Average price over 6 months on both sides of the look back period[2]

We then construct model portfolios of long-short strategies that buy the most undervalued and sell the most overvalued commodities based on these historical price value metrics. As we have shown in the past (see Spot price mean reversion, April 2014) doing this across the entire commodity complex (eg, long the top 12 most overvalued and short the bottom 12 undervalued among 25 commodities) does not produce positive returns over any meaningful period of time (Chart 5).

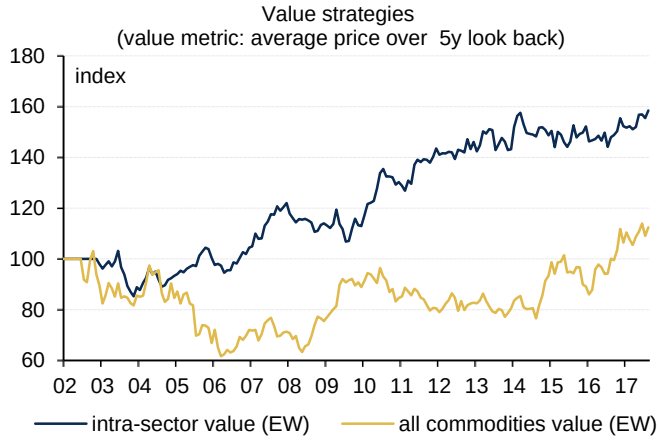
[1] See for example Asness, Clifford S., Tobias J. Moskowitz, and Lasse Heje Pedersen. "Value and momentum everywhere." The Journal of Finance 68.3 (2013): 929-985.

[2] This is the valuation metric for commodities used in "Value and momentum everywhere" (see footnote 1).

Historical price based value metrics only work within sectors

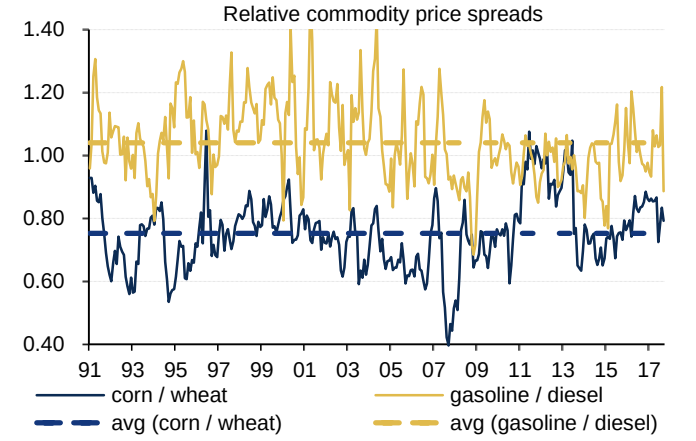
Doing the relative valuation and long-short strategy separately within each sector (energy, grains, livestock, softs, precious and base metals), however, and then equally weighting the sectors, does produce positive returns, according to our back tested analysis (Chart 5). We believe the reason behind this result is that these value metrics are not good at estimating the true fundamental value of each commodity (for the reasons mentioned above), while they do a better job of picking up differences in relative fundamental value within sectors. Because some prices are mean reverting in relative terms due to substitution effects, sector value strategies tend to perform better, in our view. In contrast to absolute price levels, relative price levels have a tendency to mean revert e.g. if there are substitution effects that bind them together in a mean reverting spread such as corn vs wheat or gasoline vs diesel (Chart 6).

Chart 5: Doing the relative valuation and long-short separately within each sector does produce positive returns



Source: Bloomberg, BofA Merrill Lynch Global Research estimates
Based on daily returns from July-1997 to Sep-2017, based on futures price data availability. Note: The strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Chart 6: Relative price levels have a tendency to mean revert if there are substitution effects that bind them in a mean reverting spread



Source: Bloomberg, BofA Merrill Lynch Global Research

Performance is modest and sensitive to parameter choices

Still, our analysis suggests the back tested performance of this kind of strategy is not great when measured in terms of risk-adjusted returns. We estimate info ratios ranging from -0.25 to 0.63 for the range of look back periods, and in most cases info ratios drop below 0.4 (Table 1). In fact, according to our back tested data, the performance is very sensitive to the choice of a look back period – the period over which we average historical prices to estimate fundamental value. Our work shows that the only reasonably robust result using this approach is an intra-sector strategy based on a valuation metric that uses the entire look back period (valuation metric 2). This strategy is similar to the one we presented in Spot price mean reversion, April 2014. Even then, we recognize that historical price-based value metrics prompts are very sensitive to parameter choice, so we move on to look for other alternatives.

Table 1: Sensitivity of historical price based value strategy performance to choice of look back period (years)

Value metric 1: Average price over entire look back period

	all-commodities			intra-sector		
look back	return	vol	info ratio	return	vol	info ratio
1y	-1.41%	14.79%	(0.10)	2.88%	7.83%	0.37
3y	0.94%	14.24%	0.07	2.45%	8.23%	0.30
5y	1.75%	14.01%	0.12	3.29%	8.31%	0.40
10y	2.02%	12.48%	0.16	3.09%	8.01%	0.39

Value metric 2: Average price over 6 months on both sides of the look back period

	all-commodities			intra-sector		
look back	return	vol	info ratio	return	vol	info ratio
1y	-3.94%	15.46%	(0.25)	3.17%	8.22%	0.39
3y	4.90%	14.76%	0.33	3.27%	7.77%	0.42
5y	1.43%	14.67%	0.10	4.84%	7.68%	0.63
10y	5.39%	13.55%	0.40	2.36%	7.91%	0.30

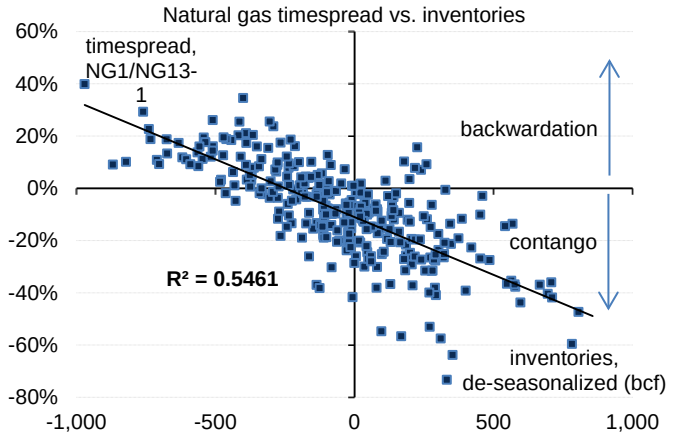
Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Based on daily returns from July-1997 to Sep-2017, based on futures price data availability. Note: The strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

An alternative approach to value is using curve as a signal for value

One good alternative option is the shape of the commodity futures curve relative to its own history. The curve shape can serve as an indicator of whether a commodity is expensive or cheap relative to its true fundamental value (i.e. its long-run cost of production). Timespreads, in contrast to price levels, have the advantage of being mean reverting and thus have more stable distributions over time. When the timespread is high, or steeply backwardated, relative to its historical average, it is usually because a supply or demand shock has caused a gap between consumption and production, which causes inventories to draw (Chart 7). So spot prices rise relative to forward prices to ration demand and to encourage more supply to come online to close the supply-demand gap and curtail the inventory drain. Supply and demand will adjust to price signals to close the gap and inventories will normalize, which means timespreads also tend to mean revert over time (Chart 8).

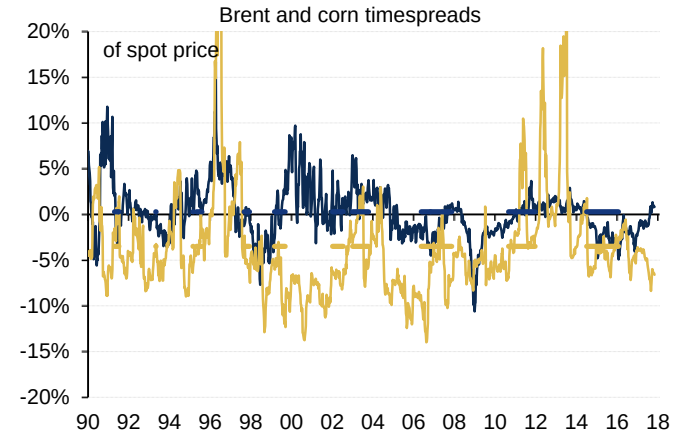
Chart 7: When the timespread is high relative to historical average it is usually because a supply or demand shock caused inventories to draw



Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Data from Jan 1990 to Mar 2017.

Chart 8: Over time supply and demand will adjust to price signals, which means timespreads tend to mean revert over time



Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Curve shape predicts spot prices over different holding periods

Recall that timespreads comprise physical storage costs, financing costs (interest rates) and convenience yield (see Commodity carry for all, September 2017). We adjust the curves by subtracting financing costs (interest rates), as these have been trending down over the last few decades, to get a cleaner measure of tightness, which only comprises physical storage costs and convenience yield with a more time-stable distribution. We then back test how the adjusted timespread relates to future spot price changes, and find that a steep curve is generally associated with negative future spot returns over various holding periods (1, 3, and 6 months, respectively). Spot prices are not tradable though, as they do not take the rolling of the futures contracts into account, so any strategy based on curve signals needs to be implemented with excess returns.

Table 2: Curve shape and future spot price changes (10% statistically significant results highlighted in yellow)

h = 1M	KC	C	CT	CL	GC	HO	LH	LC	NG	LN	SI	S	BO	SB	W	LX	CO	KW	SM	LP	QS	CC	FC
intercept	0.00	-0.01	0.00	0.00	0.01	0.01	-0.01	0.00	0.01	0.00	0.00	-0.01	0.01	0.01	0.00	0.00	0.01	0.00	-0.01	-0.01	0.01	0.00	0.00
PC1	-0.11	-0.36	-0.25	-0.21	0.01	-0.02	-0.27	-0.15	-0.54	0.22	-1.64	-0.35	-1.25	-0.09	-0.14	-0.88	0.07	-0.03	-0.30	0.38	-0.04	-0.15	-0.23
PC2	1.21	0.24	0.17	1.36	0.45	1.47	-0.87	-1.20	-0.83	-1.99	-0.01	0.61	2.51	-0.33	-0.11	1.70	-0.89	-0.06	0.55	-1.95	1.95	0.18	-0.62

h = 3M	KC	C	CT	CL	GC	HO	LH	LC	NG	LN	SI	S	BO	SB	W	LX	CO	KW	SM	LP	QS	CC	FC
intercept	-0.01	-0.02	0.00	0.02	0.02	0.03	0.00	0.01	-0.01	0.01	0.01	-0.03	0.01	0.03	-0.01	0.01	0.03	0.00	-0.04	-0.02	0.03	0.01	0.01
PC1	-0.56	-0.93	-0.39	-0.69	-1.13	0.14	-0.36	0.07	-0.31	0.05	-3.27	-0.60	-2.51	-0.55	-0.53	-2.83	-0.01	-0.23	-0.47	0.93	-0.22	-0.33	-0.74
PC2	0.39	1.18	1.60	3.77	-0.82	3.23	-2.85	-2.60	-3.86	-10.70	1.37	2.30	1.94	-1.69	0.09	2.42	-4.46	-0.45	2.41	-4.71	4.96	2.05	-2.28

h = 6M	KC	C	CT	CL	GC	HO	LH	LC	NG	LN	SI	S	BO	SB	W	LX	CO	KW	SM	LP	QS	CC	FC
intercept	-0.01	-0.03	0.01	0.03	0.03	0.06	0.03	0.01	-0.02	0.03	0.02	-0.05	0.00	0.06	-0.01	0.04	0.06	0.01	-0.07	-0.05	0.05	0.02	0.03
PC1	-1.01	-1.89	-0.68	-1.09	-5.18	0.28	0.11	0.46	-0.57	-0.95	-8.24	-1.06	-4.14	-0.81	-1.02	-4.84	-0.41	-0.66	-1.03	2.45	0.31	-0.48	-0.73
PC2	-0.50	2.90	3.59	7.66	-9.49	2.16	-3.81	-1.91	-4.36	-20.44	3.33	4.18	-2.50	-3.79	-0.26	2.66	-5.28	-2.17	4.03	-3.72	7.80	5.34	-4.90

Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Note: PC1 and PC2 are the first two principle components from a PCA on different timespreads across the curve. Potentially there is signal value not just in the slope of the curve but also the curvature- e.g. a steeply backwardated curve which is most steep in the front is symptomatic of a severe shortage which the market is working fast to rebalance. Therefore instead of using just a single timespread (i.e. the curve slope between two points) we use several timespreads across the curve, and reduce the dimensionality of these into a smaller set of two uncorrelated principle components (which combined on average capture 99% of the variation in all the timespreads). Data from July 1997 to September 2017, based on availability of all included commodity futures prices for consistent sample lengths.

Negative carry erodes returns over very short holding periods

When turning the curve signal into a tradable strategy using excess return indices, we find that the positive spot returns are mostly eroded by negative carry returns for short holding periods (1 month). Even if they mean revert over long periods of time, forward curves are sticky in the short term because it takes time for supply and demand to rebalance. This curve value strategy stays short the backwardated commodities and long the contangoed ones, and hence tends to suffer negative carry returns on both positions if the curve shape remains unchanged. In other words, the curve value strategy suffers from negative carry returns while it waits for the curves to mean revert to fundamental value.

Table 3: Value strategies using curve signals over 1-month holding period

Value metric 1: Average price over entire look back period

	all-commodities			intra-sector		
look back	return	vol	info ratio	return	vol	info ratio
1y	-0.37%	12.45%	(0.03)	-0.67%	8.06%	(0.08)
3y	-4.03%	12.99%	(0.31)	0.10%	8.05%	0.01
5y	-2.18%	12.86%	(0.17)	0.46%	8.43%	0.05
10y	-0.80%	13.52%	(0.06)	3.17%	8.44%	0.38

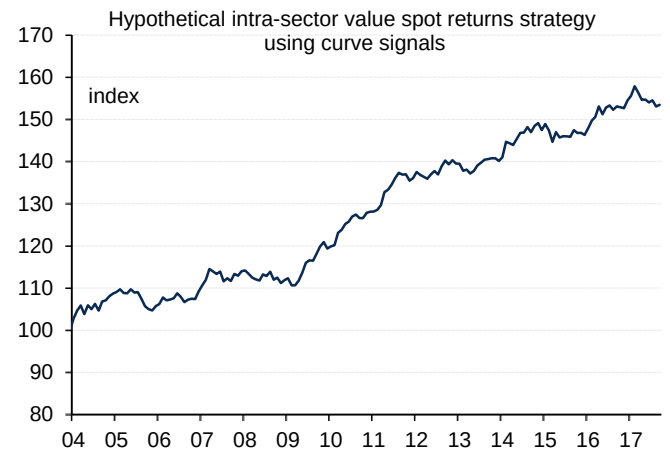
Value metric 2: Average price over 6 months on both sides of the look back period

	all-commodities			intra-sector		
look back	return	vol	info ratio	return	vol	info ratio
1y	-2.02%	13.15%	(0.15)	-2.37%	8.56%	(0.28)
3y	-0.48%	12.84%	(0.04)	4.30%	10.13%	0.42
5y	5.41%	13.44%	0.40	3.97%	9.64%	0.41
10y	4.45%	13.26%	0.34	4.17%	8.01%	0.52

Source: Bloomberg, BofA Merrill Lynch Global Research estimates

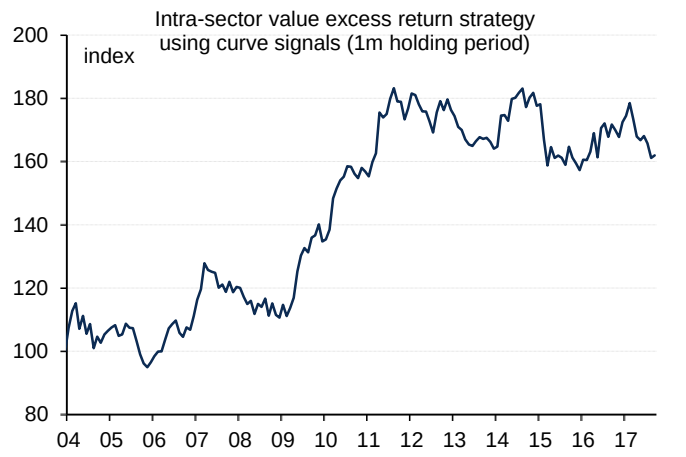
Based on daily returns from Jul-1998 to Sep-2017, chosen for consistent sample period with existing value (price) strategy. Note: The strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Chart 9: When turning the curve signal into a tradable strategy using excess return indices…



Source: Bloomberg, BofA Merrill Lynch Global Research estimates
Based on monthly returns from Jul-1998 to Sep-2017, chosen for consistent sample period with existing value (price) strategy. Note: The strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.
Note: Average price over 6 months on both sides of the 5yr look back period

Chart 10: …we find that the positive spot returns are mostly eroded by negative carry returns for short holding periods



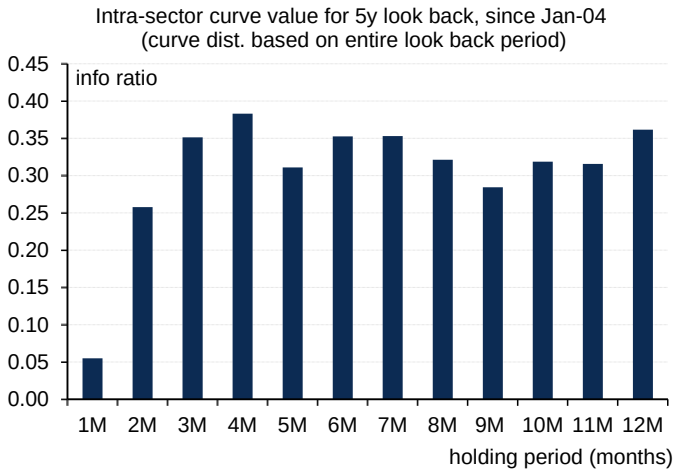
Source: Bloomberg, BofA Merrill Lynch Global Research estimates
Based on monthly returns from Jul-1998 to Sep-2017, chosen for consistent sample period with existing value (price) strategy. Note: The strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.
Note: Average price over 6 months on both sides of the 5yr look back period

Value takes time to play out- longer holding periods may improve performance

So in the curve value strategy, we need to have a long enough holding periods to allow mean reversion to play out to offset the negative carry returns earned while waiting for mean reversion to happen. And a 1-month holding period is not enough for mean reversion to play out. Our back tested analysis suggests that that the risk-adjusted returns rise significantly as the holding period increases from 1 to 3 months after which the risk-adjusted return stabilizes in holding period[3] (Chart 11). And this result is robust to the choice of a look back period (for the same sample window) (Chart 12). A longer look back period tends to yield more stable curve distribution estimates. Thus, we find that the longer the look back, the higher the risk-adjusted returns for the same holding period. That said our back tested analysis suggests that there is not much difference between performances for a 5- and 10-year look back, for a 3-6 month holding period. So we stick to a 5-year look back in our strategy in order to get as long a back test as for our existing value (price) strategy which starts in 2004 (Chart 13 below).

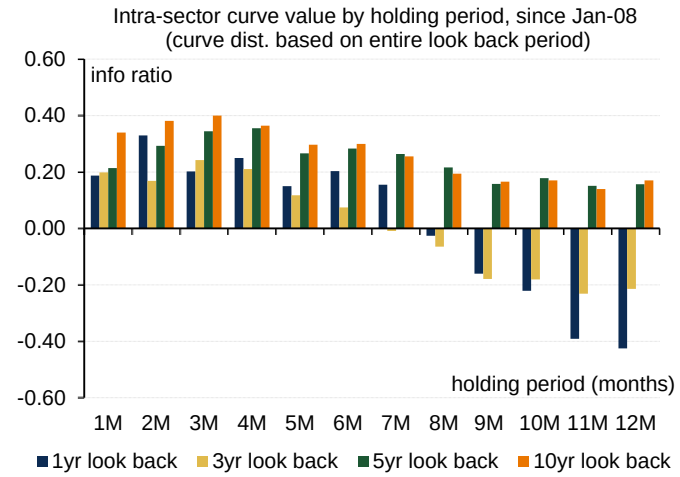
[3] We use overlapping holding periods as suggested in Jegadeesh and Titman (1993).

Chart 11: Back tested risk-adjusted returns rise significantly as the holding period increases from 1 to 3 months and then stabilizes



Source: Bloomberg, BofA Merrill Lynch Global Research estimates
Based on monthly returns from Jul-1998 to Sep-2017, chosen for consistent sample period with existing value (price) strategy. Note: The strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Chart 12: And this back tested result is robust to the choice of a look back period (for the same sample window)



Source: Bloomberg, BofA Merrill Lynch Global Research estimates
Based on monthly returns from Jul-1998 to Sep-2017, chosen for consistent sample period with existing value (price) strategy. Note: The strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Curve has both value and momentum signal value, which complement well

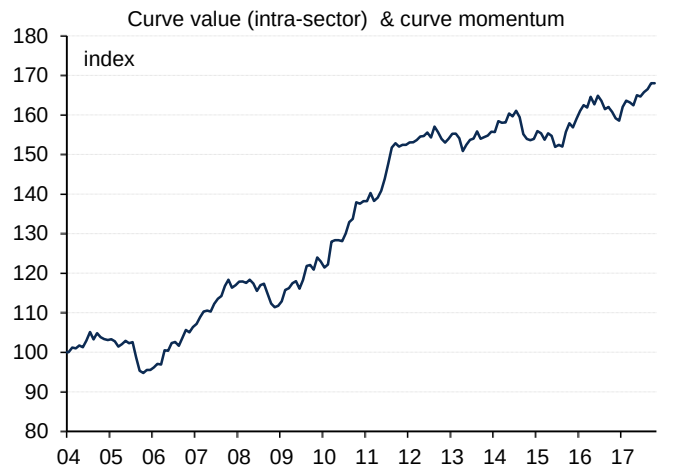
This new curve value strategy is conceptually similar, and yet opposite, to our curve momentum strategies (also sometimes known as backwardation strategies, see Curve Momentum, April 2011, and Sector Curve Momentum, July 2013). Curve momentum strategies go long backwardated and short contangoed commodities, while curve value does the opposite. The key difference between the two strategies is in the holding period[4]. Over a short period such as 1-month holding period, it is likely that the curve shape will be sticky, so curve momentum performs due to earning positive carry on both the long and the short leg, while value (based on curve shape) does not. Over longer periods, such as a 3-month holding period, however, curves tend to mean revert and value performs. So the two strategies are negatively correlated, and adding curve momentum (info ratio: 0.6) to curve value (info ratio: 0.4) increases the risk adjusted returns (info ratio: to 0.8) and also significantly reduces the drawdowns (Chart 13 and Chart 14).

[4] Aside from the holding period the other key difference is that in curve momentum we overweight the curves which are relatively steeper (highest expected roll yield) relative to other commodities. In value we assess each curve shape relative to its own historical distribution.

Chart 13: Adding curve momentum (info ratio: 0.63) to curve value (info ratio: 0.33) increases the back tested risk-adjusted returns (info: 0.8)…

Source: Bloomberg, BofA Merrill Lynch Global Research estimates
Based on monthly returns from Jul-1998 to Sep-2017, chosen for consistent sample period with existing value (price) strategy. Note: The strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Chart 14: …and also significantly reduces the drawdowns



Source: Bloomberg, BofA Merrill Lynch Global Research estimates
Based on monthly returns from Jul-1998 to Sep-2017, chosen for consistent sample period with existing value (price) strategy. Note: The strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

The sectorial approach suggests being explicit about spread mean reversion

The fact that our analysis suggests that historical price and curve based valuation metrics only work within sectors, not across the entire commodity complex, suggests that these value metrics do not do a great job of capturing value of a commodity relative to its own fundamental value. Or maybe it simply takes too long for mean-reversion to own-fundamental value to occur for the strategy to capture it. Instead these value metrics do a reasonable job of capturing relative value within sectors where some prices are mean reverting. So rather than assuming mean reversion within an entire sector we also try to be explicit about which cross-commodity spreads could potentially be mean reverting, test whether they actually are, and if so, then we trade on it. Mean reversion in relative value (spreads) is generally much faster than mean reversion to absolute fundamental value, so the choice of holding period is less of an issue.

Correlation doesn't imply mean reversion unless there are substitution effects

High correlation is usually a good starting point to look for mean reverting spreads for example within the energy or ags sectors where cross-commodity correlations are generally high (Table 4). But correlation of *returns* does not necessarily imply mean reversion in price *levels*. For spreads to be mean-reverting in levels there has to be a good fundamental reason for why they mean revert to a given spread – there has to be large and relatively fast substitution effects on either the supply or the demand side for both commodities in the spread, or maybe they are sufficiently vertically intergraded i.e. one is a material input in the production of the other. So we pick our spread candidates based on spreads which we think theoretically could be mean reverting due to substitution or vertical integration effects, and then test empirically whether the they are indeed mean reverting in the short term[5].

[5] Our mean reversion test is based on a rolling regression over a 10-year window of the 1st variable on the 2nd variable (with some control variables including seasonal dummies) both in levels. We test for co-integration between the two variables using the Augmented Dickey-Fuller test to determine if the residual from the regression is stationary. If a cointegrating relationship is found between the two variables (i.e. the residual is

Table 4: Monthly pairwise commodity return correlations (percent)

	energy						base				precious				ags						soft				livestock		
	CL	CO	XB	HO	QS	NG	LA	HG	LN	LX	GC	SI	PL	PA	W	KW	C	S	BO	SM	KC	CT	SB	CC	LH	LC	FC
CL		95	86	91	89	34	26	32	20	18	15	18	25	25	14	14	13	18	16	16	7	17	8	18	10	6	9
CO	95		87	91	92	31	27	34	22	21	18	20	28	25	13	13	14	21	18	19	6	20	10	21	9	6	9
XB	86	87		87	84	36	24	33	23	18	16	19	27	24	14	15	14	16	15	14	6	16	9	19	6	3	7
HO	91	91	87		95	44	26	32	22	15	17	17	24	21	12	12	13	20	16	20	1	15	9	13	11	3	7
QS	89	92	84	95		37	22	30	20	15	16	17	23	19	11	12	12	20	16	20	1	15	8	14	12	3	8
NG	34	31	36	44	37		6	5	9	2	9	5	12	10	9	9	13	10	4	12	2	4	7	-2	11	-2	-3
LA	26	27	24	26	22	6		65	54	56	20	26	38	35	11	11	14	20	22	12	12	20	19	7	1	4	-1
HG	32	34	33	32	30	5	65		53	64	28	34	45	38	20	20	17	25	30	16	15	29	19	17	3	4	5
LN	20	22	23	22	20	9	54	53		51	21	29	39	30	12	13	15	18	14	17	14	18	10	4	-4	-1	-3
LX	18	21	18	15	15	2	56	64	51		28	34	41	32	15	13	15	13	19	7	17	19	20	11	9	6	5
GC	15	18	16	17	16	9	20	28	21	28		73	59	25	18	19	18	16	17	12	17	12	11	18	3	-7	-11
SI	18	20	19	17	17	5	26	34	29	34	73		61	37	14	15	22	19	19	14	21	14	11	21	1	-7	-7
PL	25	28	27	24	23	12	38	45	39	41	59	61		57	18	22	20	22	24	16	23	29	24	22	-3	6	4
PA	25	25	24	21	19	10	35	38	30	32	25	37	57		15	18	17	16	15	11	20	24	22	13	-4	6	6
W	14	13	14	12	11	9	11	20	12	15	18	14	18	15		95	63	52	41	50	14	24	13	11	7	2	-12
KW	14	13	15	12	12	9	11	20	13	13	19	15	22	18	95		59	49	40	46	18	23	16	10	6	4	-9
C	13	14	14	13	12	13	14	17	15	15	18	22	20	17	63	59		71	53	66	16	36	13	17	1	-1	-23
S	18	21	16	20	20	10	20	25	18	13	16	19	22	16	52	49	71		75	91	20	40	17	17	1	3	-12
BO	16	18	15	16	16	4	22	30	14	19	17	19	24	15	41	40	53	75		47	16	42	14	16	5	4	-5
SM	16	19	14	20	20	12	12	16	17	7	12	14	16	11	50	46	66	91	47		16	30	14	12	-3	3	-11
KC	7	6	6	1	1	2	12	15	14	17	17	21	23	20	14	18	16	20	16	16		14	14	16	-4	-2	-2
CT	17	20	16	15	15	4	20	29	18	19	12	14	29	24	24	23	36	40	42	30	14		12	20	-2	-1	-7
SB	8	10	9	9	8	7	19	19	10	20	11	11	24	22	13	16	13	17	14	14	14	12		12	-9	1	-6
CC	18	21	19	13	14	-2	7	17	4	11	18	21	22	13	11	10	17	17	16	12	16	20	12		-1	-4	-6
LH	10	9	6	11	12	11	1	3	-4	9	3	1	-3	-4	7	6	1	1	5	-3	-4	-2	-9	-1		33	29
LC	6	6	3	3	3	-2	4	4	-1	6	-7	-7	6	6	2	4	-1	3	4	3	-2	-1	1	-4	33		82
FC	9	9	7	7	8	-3	-1	5	-3	5	-11	-7	4	6	-12	-9	-23	-12	-5	-11	-2	-7	-6	-6	29	82	

Source: Bloomberg, BofA Merrill Lynch Global Research estimates

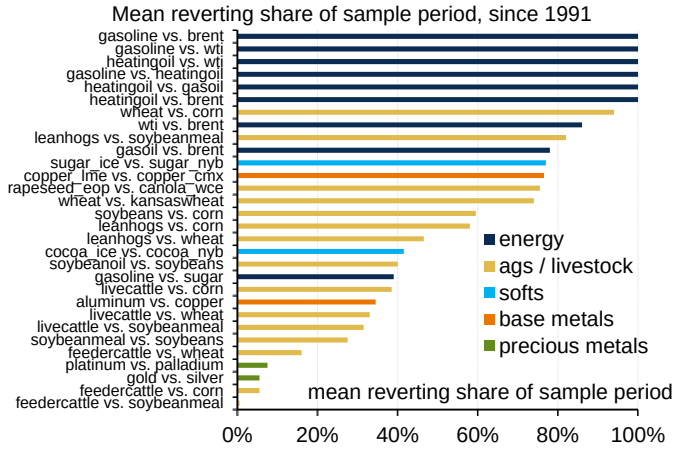
Based on monthly returns from Jan-1991 to Sep-2017, chosen based on futures price availability. With the exception that Alu and Copper futures prices only start in July-1997

We find many mean reverting spreads in the energy space

The energy space is ripe with mean reverting spreads (Chart 15). In the refining sector, oil products such as gasoline and diesel are produced from crude oil (WTI, Brent) and the global refining sector generally has some spare capacity to ramp up production at relatively short notice in response to margins. So the crack spreads—gasoline vs Brent or heating oil vs Brent—historically show a strong tendency to mean revert. Oil product spreads also tend to mean revert, not because gasoline and diesel are substitutes in consumption—in the short term they are not, as cars are built to run on one or the other and the car fleet only rolls over very slowly. Instead, product spreads mean revert because on the supply side refiners have some flexibility to tweak yields between different products such as gasoline and diesel in response to their relative prices (Chart 16).

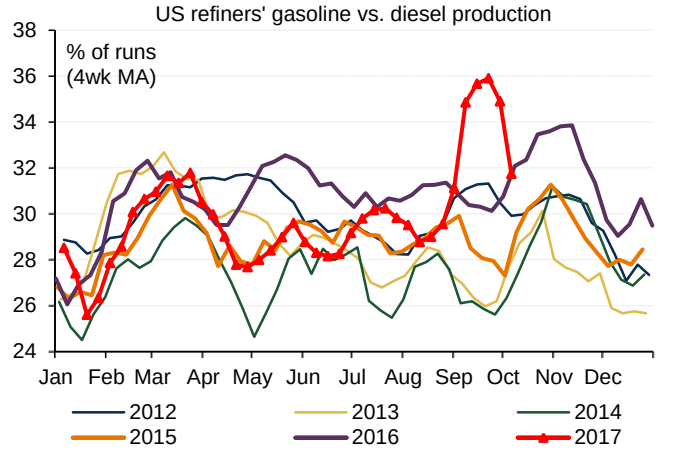
stationary) it implies that the spread, which we have estimated with the regression, is mean reverting. For each spread we define the share of the roll windows where mean reversion is found as the "mean reverting share of sample period" and use this as a measure of the degree of stability of the mean reversion of the spread.

Chart 15: The energy space is ripe with mean reverting spreads, e.g. in the refining sector where oil products are produced from crude oil



Source: Bloomberg, BofA Merrill Lynch Global Research estimates
Based on daily returns from Jan-1991 to Sep-2017, chosen based on futures price availability. With the exception that Alu and Copper futures prices only start in July-1997.

Chart 16: Product spreads mean because on the supply side refiners have some flexibility to tweak yields between different products



Source: Bloomberg, BofA Merrill Lynch Global Research

...some mean reversion in agricultural spreads...

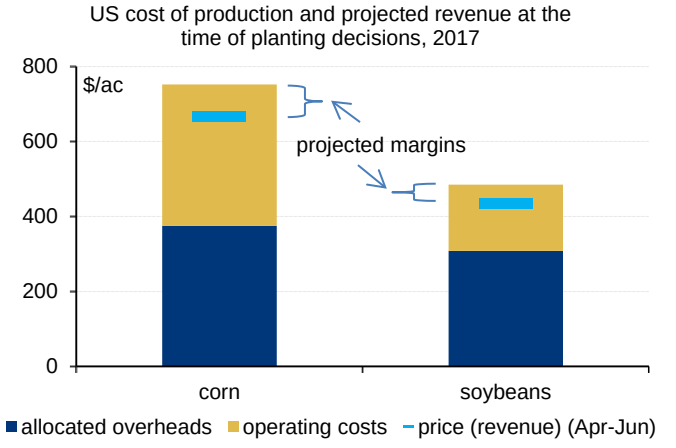
In the agricultural space, we have a number of spreads derived from substitution effects. For example, corn and wheat are substitutes as a source of carbohydrates in animal feed, and corn and soy can grow in similar climates and are planted at the same time, so are substitutes for plantings on the same acreage (Chart 17). Many of the geographical spreads also turn out to be mean-reverting, such as Kansas Wheat and Chicago Wheat, which are very close substitutes only separated by 400 miles between delivery points. That is also the case for sugar listed on ICE (Europe) and NYMEX (USA). Vertical spreads are also prevalent in ags; however, a simple two variable pair spread such as between lean hogs and corn often does not mean revert as it only captures part of the producer's margin. We find that when we test for mean reversion of the full margin such as for lean hogs vs corn, wheat and soybean meal, or soybean vs soybean oil and soybean meal, we get more stable spreads.

...and very little mean reversion in the base and precious metals space

In the metals space, we find that copper on CMX and copper on LME are also mean reverting, which in our view is not all that surprising, given that they are close substitutes. Apart from geographical substitution spreads, however, there is very limited substitution between commodities in the metal space. The best examples of commodities that are highly correlated yet not mean reverting are base and precious metals (Chart 18). Copper and aluminum are highly correlated, as demand for both moves on macroeconomic activity, yet there are few short-term substitution effects between the two, so they do not tend to mean revert to any particular constant spread. Similarly, gold vs silver are highly correlated, as demand for both moves on investor demand, both positively correlated to risk aversion, but they do not mean revert, as there are hardly any substitution effects between the two in industrial uses[6].

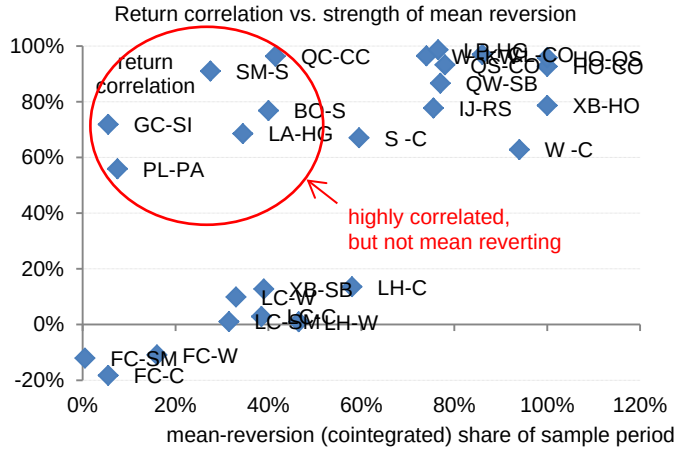
[6] In theory they are substitutes in demand for precious metals for jewelry production, but the relative popularity of the two changes over time, so any actual substitution between the two in jewelry demand is not sufficient to cause the two prices to mean revert in the short term.

Chart 17: Corn and soy can grow in similar climates and are planted at the same time so are substitutes for plantings on the same acreage



Source: USDA, BofA Merrill Lynch Global Research estimates

Chart 18: The best examples of commodities that are highly correlated yet not mean reverting we find in the base and precious metals space



Source: Bloomberg, BofA Merrill Lynch Global Research estimates
Based on daily returns from Jan-1991 to Sep-2017, chosen based on futures price availability. With the exception that Alu and Copper futures prices only start in July-1997.

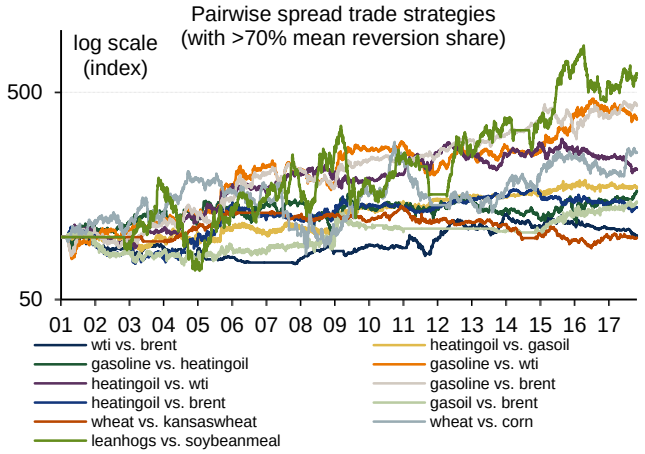
We seek to turn spread mean reversion into tradable strategies…

In total we have identified 30 spread pairs based on ex ante theoretical considerations, so for the purpose of designing a spread trading strategy, we need to test whether these spread candidates are indeed mean reverting, rather than trading on the presumption that they are. Each month, we estimate the long-term spread using a linear regression over a 10-year backward looking window, test for mean reversion of the spread (i.e. checking if residual from regression is mean reverting using a cointegration test). If mean reversion is found, then we short the spread if the last residual is positive – implying the spread is above it long term mean reverting value – and go long the spread if the residual is negative – implying the spread is below its long term mean reverting value (Chart 19).

…and find a strong link between strength of mean reversion and performance

Our back tested analysis suggests find that the risk adjusted returns on these spread trading strategies is closely and positively linked to the how much of the sample period the spread is indeed mean reverting for (Chart 20). In other words, the more stable the mean reverting relationship is, the better the spread trading strategy would be expected to perform. Of the 30 spread candidates our back tested data indicates that 14 of these are mean reverting more than 70% of the time, and all of these have positive risk-adjusted returns (info ratios ranging from 0.03 to 0.62) with an average info ratio of 0.29.

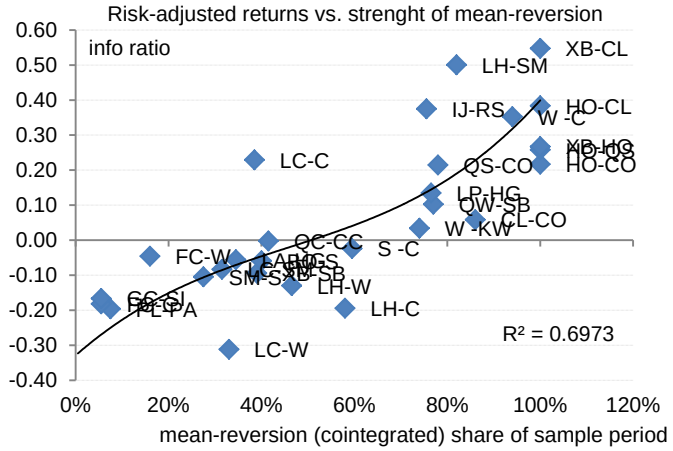
Chart 19: If mean reversion is found, then we short the spread if its above its long term fundamental value, and go short if its below value



Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Based on daily returns from Jan-1991 to Sep-2017, chosen based on futures price availability. With the exception that Alu and Copper futures prices only start in July-1997. Note: The value(spread) strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Chart 20: In other words the more stable the mean reverting relationship the better the spread trading strategy performs



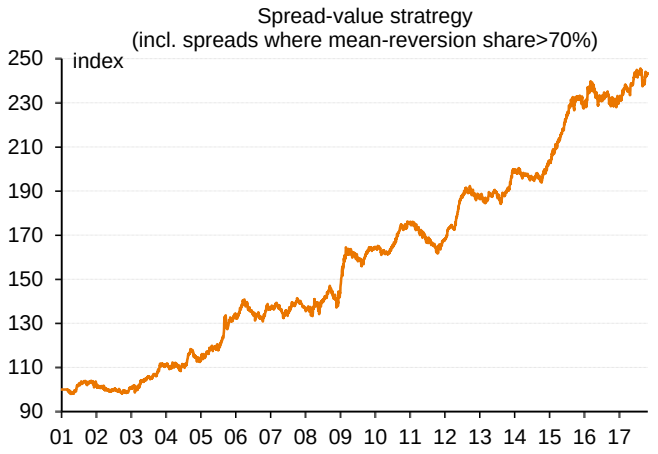
Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Based on daily returns from Jan-1991 to Sep-2017, chosen based on futures price availability. With the exception that Alu and Copper futures prices only start in July-1997. Note: The value(spread) strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Diversifying across the stable spreads vastly improves risk adjusted returns

When we combine the 14 stable spread trading strategies into an equal weighted basket the information ratio increases dramatically to 1.0 due to diversification benefits (Chart 21). The cutoff for how often we need to find mean reversion to include the spread in the basket is a somewhat arbitrary parameter choice, yet the link between tendency to mean revert and higher risk-adjusted returns of the individual spread is clear (Chart 20 above), so the results are fairly robust to any reasonable choice of this parameter. A cutoff anywhere between 50 and 95% still yields risk-adjusted returns of more than 0.8 (info ratio) (Chart 22). There is a trade-off between setting the cutoff higher to including only increasingly stable spreads (with on average higher info ratios) and losing some diversification benefits as fewer spreads are included.

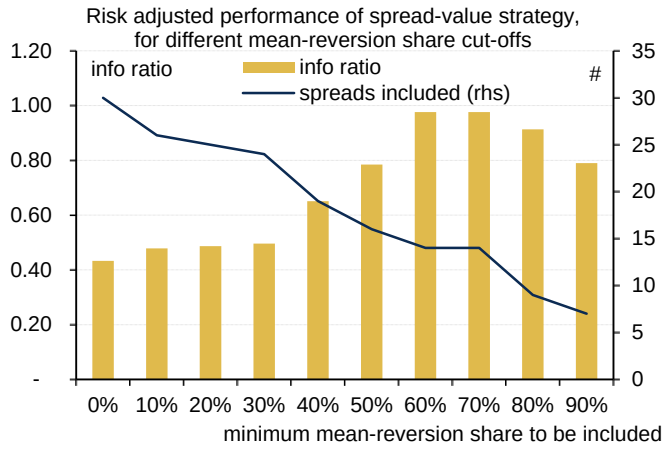
Chart 21: When we combine the 14 spread trading strategies into an equal weighted basket performance increases dramatically



Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Based on daily returns from Jan-1991 to Sep-2017, chosen based on futures price availability. With the exception that Alu and Copper futures prices only start in July-1997. Note: The value(spread) strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Chart 22: A cut off anywhere between 50 and 95% still yields risk-adjusted returns of more than 0.8 (info ratio)



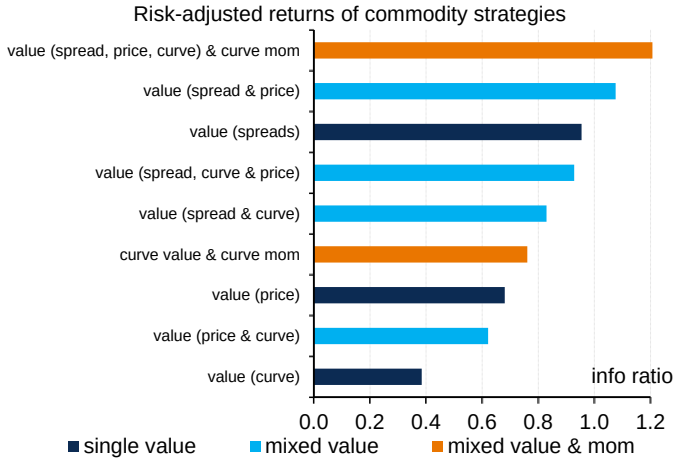
Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Based on daily returns from Jan-1991 to Sep-2017, chosen based on futures price availability. With the exception that Alu and Copper futures prices only start in July-1997. Note: The value(spread) strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Adding value to value enhances risk-adjusted returns and reduces drawdowns

Our thee value strategies, (1) intra-sector price, (2) intra-sector curve and (3) spread value, complement each other well due to very low cross-strategy correlations, especially the value spread strategy as it has negative correlations with both the others (Table 5). So by combining them we can enhance risk-adjusted returns and reduce drawdowns. Adding price value (info ratio: 0.7) to spread value (info ratio: 1.0) increases the combined info ratio to 1.1, and further adding curve value & curve momentum boosts the info ratio to 1.2 (Chart 23). Moreover, the individual value strategy drawdowns are vastly reduced in combinations due to the negative correlations (Chart 24). In fact our value strategies are negatively correlated with most other systematic commodity strategies, especially momentum, which we believe underscores the value of adding value strategies to a diversified portfolio of systematic commodity strategies.

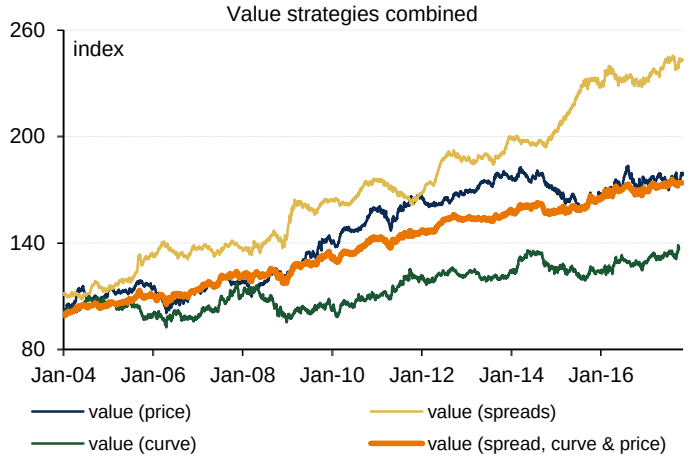
Chart 23: Adding price value to spread value increases the info ratio to 1.1, and adding curve value and curve momentum boosts it to 1.2



Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Info ratios calculated based on daily returns from Jan-2004 to Sep-2017, chosen for longest common sample period. Note: The strategies value (spreads) and value (curve) are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Chart 24: The individual value strategy drawdowns are vastly reduced in combinations of value strategies, due to the negative correlations



Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Info ratios calculated based on daily returns from Jan-2004 to Sep-2017, chosen for longest common sample period. Note: The strategies value (spreads) and value (curve) are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Table 5: Cross-strategy correlation (monthly returns, since 2004)

	volatility	congestion	carry	contrarian	momentum (price)	momentum (curve)	momentum (curve, sector)	value (price, sector)	value (curve, sector)	value (spreads)
volatility		3%	-6%	1%	-15%	-1%	14%	18%	8%	11%
congestion	3%		54%	14%	9%	1%	20%	-1%	5%	1%
carry	-6%	54%		10%	15%	-8%	22%	-6%	0%	-4%
contrarian	1%	14%	10%		-20%	-7%	2%	20%	12%	-21%
Momentum (price)	-15%	9%	15%	-20%		-20%	11%	-6%	-13%	-6%
Momentum (curve)	-1%	1%	-8%	-7%	-20%		-5%	-9%	-3%	26%
Momentum (curve, sector)	14%	20%	22%	2%	11%	-5%		6%	0%	-4%
Value (price, sector)	18%	-1%	-6%	20%	-6%	-9%	6%		10%	-7%
Value (curve, sector)	8%	5%	0%	12%	-13%	-3%	0%	10%		-15%
Value (spreads)	11%	1%	-4%	-21%	-6%	26%	-4%	-7%	-15%	

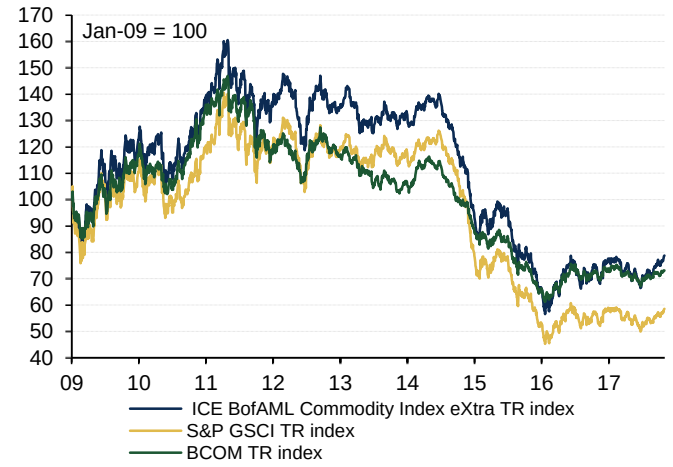
Source: Bloomberg, BofA Merrill Lynch Global Research estimates

Correlations calculated based on monthly returns from Jan-2004 to Sep-2017, chosen for longest common sample period. With the exception of volatility which starts in Jan-08. Note: Note: The value (spread) and value (curve) strategies are new and the back-tested performance reflects application of the strategy prior to its inception date as if the strategy had been in existence at that time. This does not reflect actual performance of any account or strategy, and as such, does not reflect the deduction of advisory fees or transaction costs typically associated with account performance. It is not intended to be indicative of actual or future performance. The actual performance of the strategy may vary significantly from the back-tested performance. The back-tested performance results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for all financial risks that may affect the performance of the strategy going forward.

Commodities Portfolio

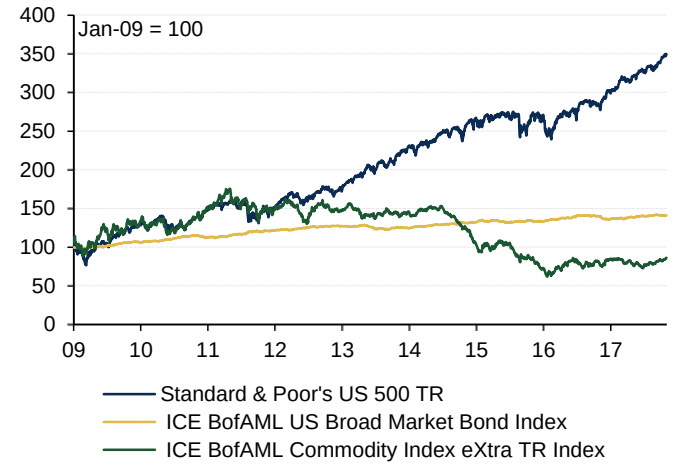
The ICE BofAML Commodity Index eXtra

Chart 25: Performance of total return commodity indices



Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

Chart 26: Performance of commodities vs other asset classes



Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

Table 6: Performance of total return commodity indices

Benchmark	S&P GSCI	BCOM
ICE BofAML Commodity Index eXtra alpha* relative to benchmark	2.99%	1.54%
ICE BofAML Commodity Index eXtra beta* relative to benchmark	0.94	1.11
ICE BofAML Commodity Index eXtra correlation with benchmark	98.63%	92.58%
Average tracking error**	3.36%	8.23%

Source: ICE, Bloomberg, BofA Merrill Lynch Global Research
Based on performance from 31-Dec-2008 to 31-Oct-2017
* Alpha and beta coefficients are annualised intercept and slope coefficients of a linear regression of ICE BofAML Commodity Index eXtra TR daily log-returns on the benchmark's daily log-returns.
** Average tracking error is the annualised residual standard deviation of a linear regression of ICE BofAML Commodity Index eXtra TR daily log-returns on the benchmark's daily log-returns.

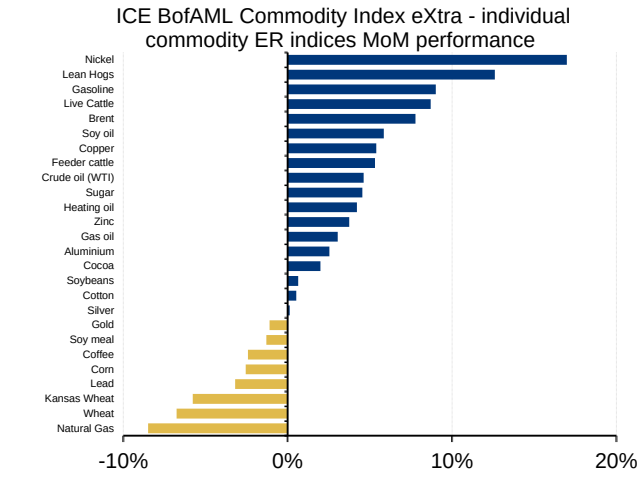
Table 7: Performance of commodities vs other asset classes

From 31-Dec-08 to 31-Oct-17	Annual return	Vol	Sharpe
Standard & Poor's US 500 TR	15.01%	16.80%	81.78%
NASDAQ 100 STOCK INDX	20.39%	18.13%	105.47%
MSCI Daily TR Gross EM USD	10.99%	17.51%	55.48%
ICE BofAML Commodity Index eXtra US Broad Market Bond Index	4.00%	3.47%	78.73%
ICE BofAML Commodity Index eXtra TR	-2.32%	20.47%	-17.56%
S&P GSCI TR	-5.54%	21.59%	-31.54%
BCOM TR	-3.24%	15.73%	-28.68%
3-month T-bill returns (risk-free)	1.27%		

Source: ICE, Bloomberg, BofA Merrill Lynch Global Research
Annualised performance based on daily returns from 31-Dec-2008 to 31-Oct-2017

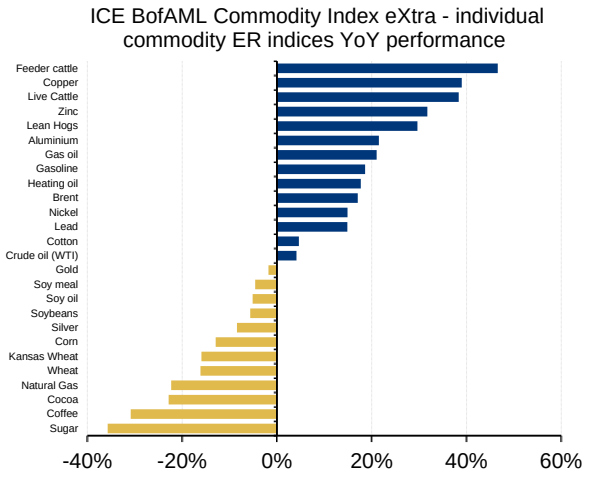
ICE BofAML Commodity Index eXtra sub-indices

Chart 27: Performance month-on-month (MoM)



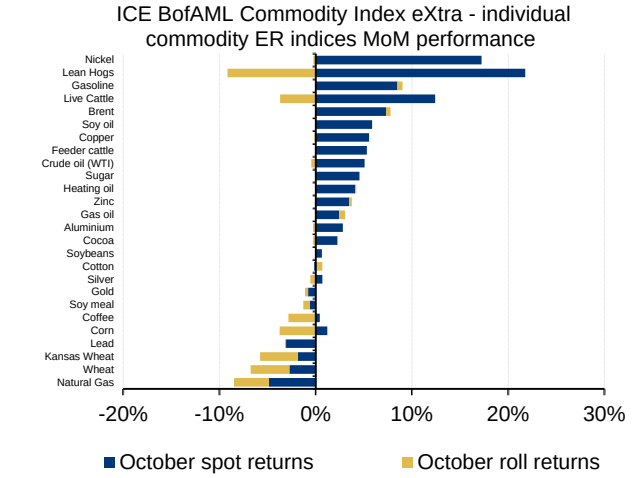
Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

Chart 28: Performance year-on-year (YoY)



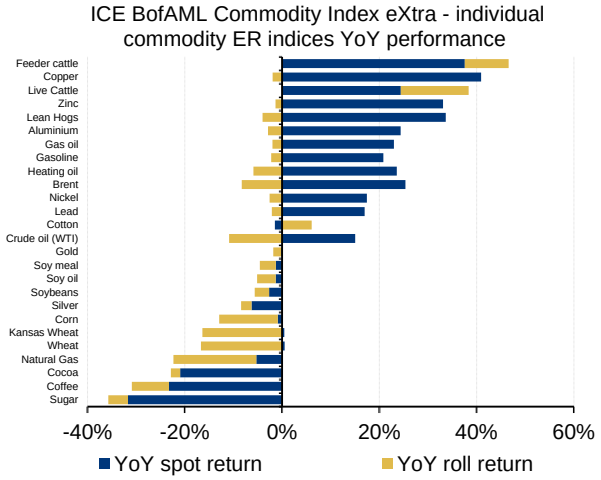
Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

Chart 29: Spot and roll returns month-on-month (MoM)



Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

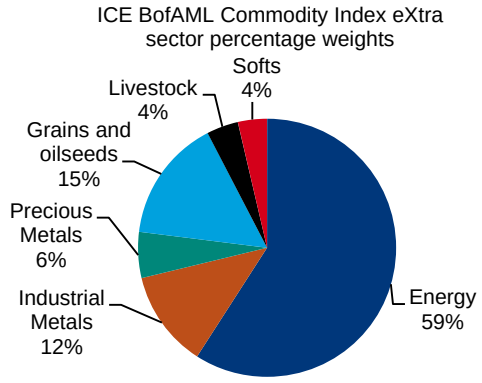
Chart 30: Spot and roll returns year-on-year (YoY)



Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

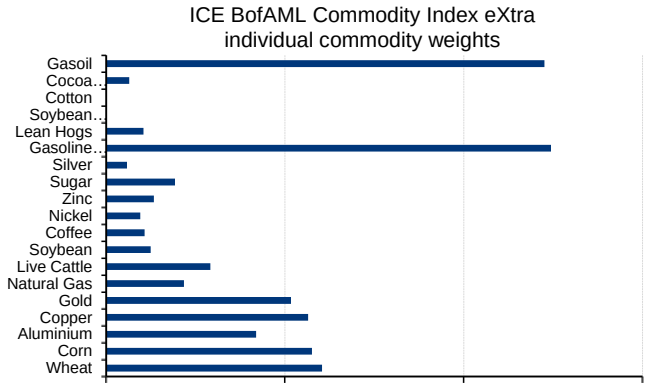
Weights and contracts

Chart 31: Sector weights in the ICE BofAML Commodity Index eXtra



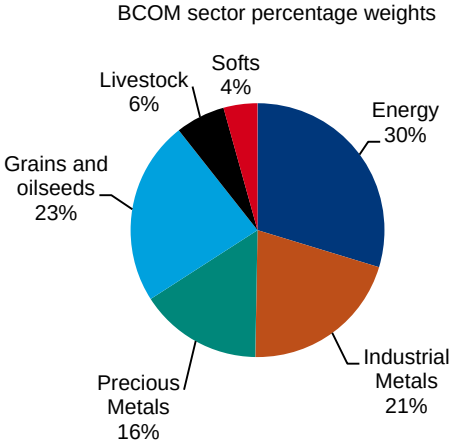
Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

Chart 32: ICE BofAML Commodity Index eXtra individual commodity



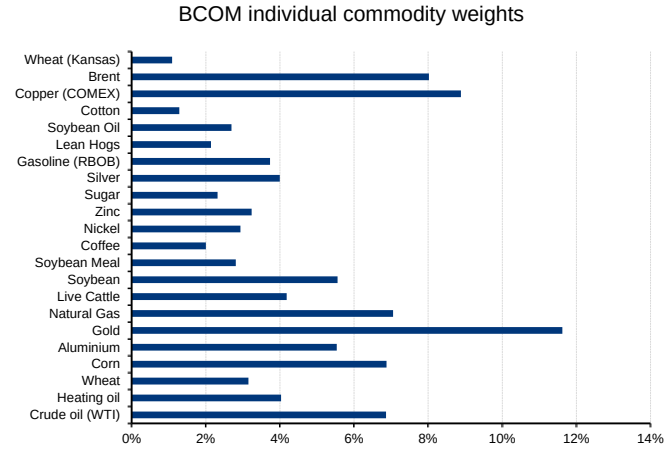
Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

Chart 33: Sector weights in the BCOM



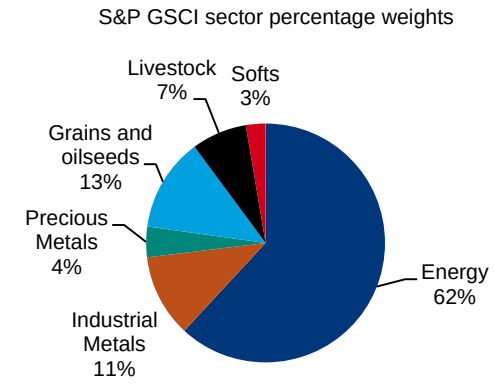
Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

Chart 34: BCOM individual commodity weights



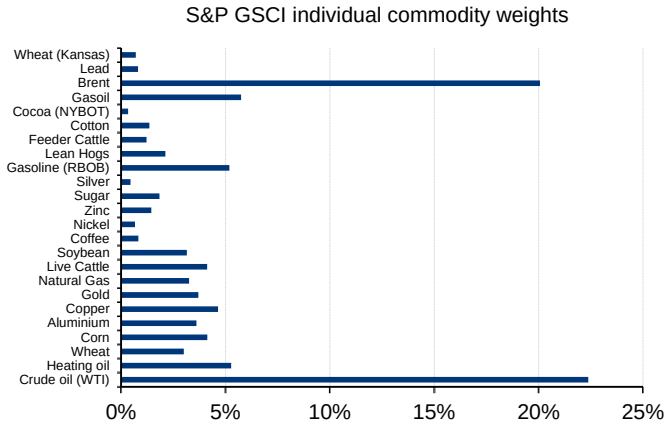
Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

Chart 35: Sector weights in the S&P GSCI



Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

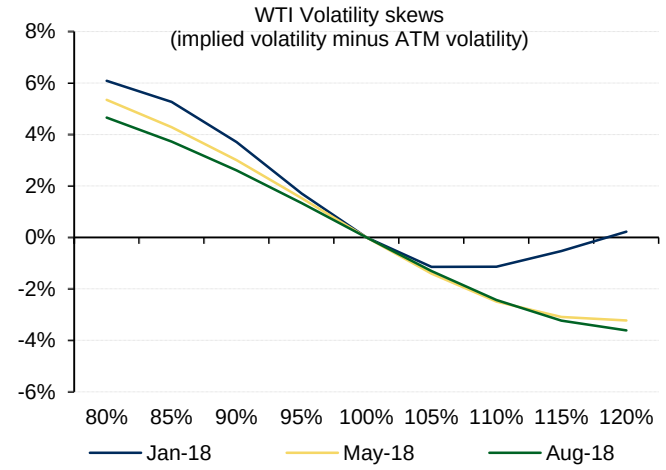
Chart 36: S&P GSCI individual commodity weights



Source: ICE, Bloomberg, BofA Merrill Lynch Global Research

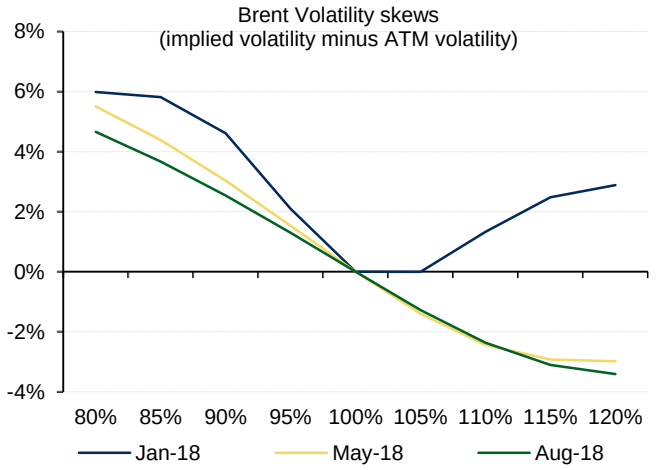
Energy Volatility Skews

Chart 37: WTI Crude Oil



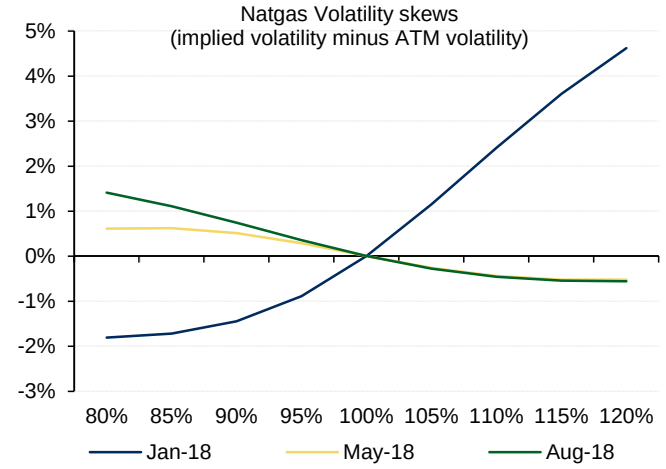
Source: Bloomberg , BofA Merrill Lynch Global Research

Chart 38: ICE – Brent Crude Oil



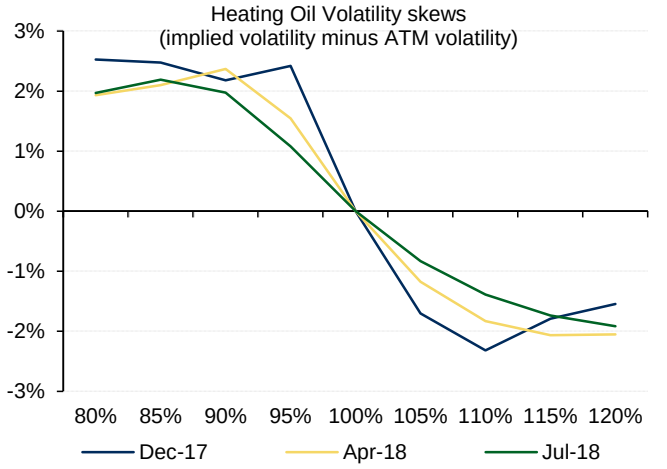
Source: Bloomberg , BofA Merrill Lynch Global Research

Chart 39: Natgas



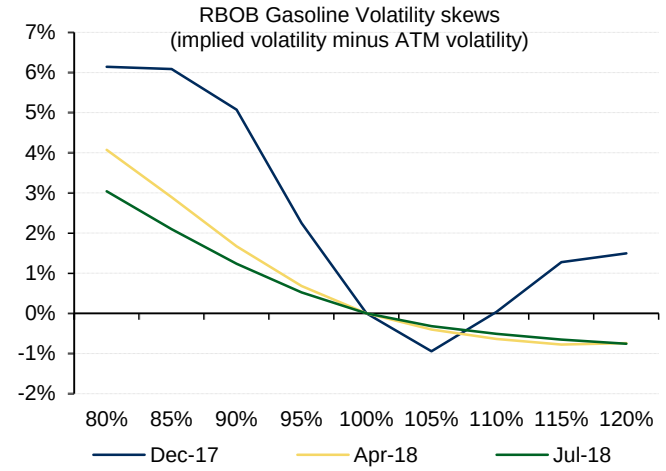
Source: Bloomberg , BofA Merrill Lynch Global Research

Chart 40: Heating Oil



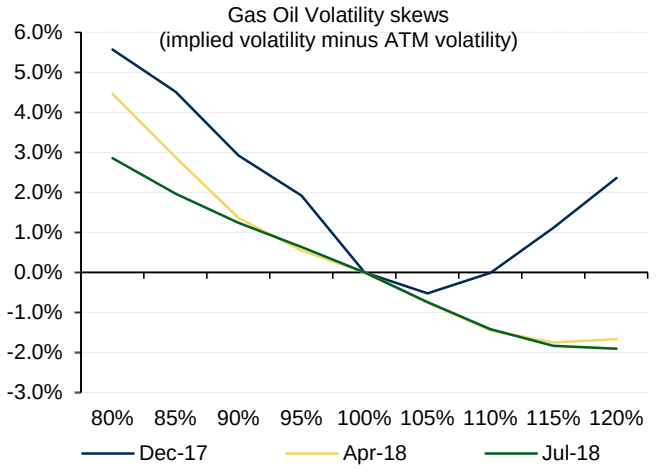
Source: Bloomberg , BofA Merrill Lynch Global Research

Chart 41: RBOB Gasoline



Source: Bloomberg , BofA Merrill Lynch Global Research

Chart 42: ICE – Gas Oil



Source: Bloomberg , BofA Merrill Lynch Global Research

Disclosures

Important Disclosures

BofA Merrill Lynch Research Personnel (including the analyst(s) responsible for this report) receive compensation based upon, among other factors, the overall profitability of Bank of America Corporation, including profits derived from investment banking. The analyst(s) responsible for this report may also receive compensation based upon, among other factors, the overall profitability of the Bank's sales and trading businesses relating to the class of securities or financial instruments for which such analyst is responsible.
BofA Merrill Lynch Global Credit Research analysts regularly interact with sales and trading desk personnel in connection with their research, including to ascertain pricing and liquidity in the fixed income markets.

Other Important Disclosures

Prices are indicative and for information purposes only. Except as otherwise stated in the report, for the purpose of any recommendation in relation to: (i) an equity security, the price referenced is the publicly traded price of the security as of close of business on the day prior to the date of the report or, if the report is published during intraday trading, the price referenced is indicative of the traded price as of the date and time of the report; or (ii) a debt security (including equity preferred and CDS), prices are indicative as of the date and time of the report and are from various sources including Bank of America Merrill Lynch trading desks.
The date and time of completion of the production of any recommendation in this report shall be the date and time of dissemination of this report as recorded in the report timestamp.

Recipients who are not institutional investors or market professionals should seek the advice of their independent financial advisor before considering information in this report in connection with any investment decision, or for a necessary explanation of its contents.
BofA Merrill Lynch Global Research policies relating to conflicts of interest are described at http://go.bofa.com/coi.
"BofA Merrill Lynch" includes Merrill Lynch, Pierce, Fenner & Smith Incorporated ("MLPF&S") and its affiliates. Investors should contact their BofA Merrill Lynch representative or Merrill Lynch Global Wealth Management financial advisor if they have questions concerning this report. "BofA Merrill Lynch" and "Merrill Lynch" are each global brands for BofA Merrill Lynch Global Research.
Information relating to Non-US affiliates of BofA Merrill Lynch and Distribution of Affiliate Research Reports:
MLPF&S distributes, or may in the future distribute, research reports of the following non-US affiliates in the US (short name: legal name, regulator): Merrill Lynch (South Africa): Merrill Lynch South Africa (Pty) Ltd., regulated by The Financial Service Board; MLI (UK): Merrill Lynch International, regulated by the Financial Conduct Authority (FCA) and the Prudential Regulation Authority (PRA); Merrill Lynch (Australia): Merrill Lynch Equities (Australia) Limited, regulated by the Australian Securities and Investments Commission; Merrill Lynch (Hong Kong): Merrill Lynch (Asia Pacific) Limited, regulated by the Hong Kong Securities and Futures Commission (HKSFC); Merrill Lynch (Singapore): Merrill Lynch (Singapore) Pte Ltd, regulated by the Monetary Authority of Singapore (MAS); Merrill Lynch (Canada): Merrill Lynch Canada Inc, regulated by the Investment Industry Regulatory Organization of Canada; Merrill Lynch (Mexico): Merrill Lynch Mexico, SA de CV, Casa de Bolsa, regulated by the Comisión Nacional Bancaria y de Valores; Merrill Lynch (Argentina): Merrill Lynch Argentina SA, regulated by Comisión Nacional de Valores; Merrill Lynch (Japan): Merrill Lynch Japan Securities Co., Ltd., regulated by the Financial Services Agency; Merrill Lynch (Seoul): Merrill Lynch International Incorporated (Seoul Branch) regulated by the Financial Supervisory Service; Merrill Lynch (Taiwan): Merrill Lynch Securities (Taiwan) Ltd., regulated by the Securities and Futures Bureau; DSP Merrill Lynch (India): DSP Merrill Lynch Limited, regulated by the Securities and Exchange Board of India; Merrill Lynch (Indonesia): PT Merrill Lynch Sekuritas Indonesia, regulated by Otoritas Jasa Keuangan (OJK); Merrill Lynch (Israel): Merrill Lynch Israel Limited, regulated by Israel Securities Authority; Merrill Lynch (Russia): OOO Merrill Lynch Securities, Moscow, regulated by the Central Bank of the Russian Federation; Merrill Lynch (DIFC): Merrill Lynch International (DIFC Branch), regulated by the Dubai Financial Services Authority (DFSA); Merrill Lynch (Spain): Merrill Lynch Capital Markets Espana, S.A.S.V., regulated by Comisión Nacional del Mercado De Valores; Merrill Lynch (Brazil): Bank of America Merrill Lynch Banco Multiplo S.A., regulated by Comissão de Valores Mobiliários; Merrill Lynch KSA Company, Merrill Lynch Kingdom of Saudi Arabia Company, regulated by the Capital Market Authority.
This research report: has been approved for publication and is distributed in the United Kingdom (UK) to professional clients and eligible counterparties (as each is defined in the rules of the FCA and the PRA) by MLI (UK) and Bank of America Merrill Lynch International Limited, which are authorized by the PRA and regulated by the FCA and the PRA, and is distributed in the UK to retail clients (as defined in the rules of the FCA and the PRA) by Merrill Lynch International Bank Limited, London Branch, which is authorized by the Central Bank of Ireland and subject to limited regulation by the FCA and PRA - details about the extent of our regulation by the FCA and PRA are available from us on request; has been considered and distributed in Japan by Merrill Lynch (Japan), a registered securities dealer under the Financial Instruments and Exchange Act in Japan; is issued and distributed in Hong Kong by Merrill Lynch (Hong Kong) which is regulated by HKSFC is issued and distributed in Taiwan by Merrill Lynch (Taiwan); is issued and distributed in India by DSP Merrill Lynch (India); and is issued and distributed in Singapore to institutional investors and/or accredited investors (each as defined under the Financial Advisers Regulations) by Merrill Lynch International Bank Limited (Merchant Bank) (MLIBLMB) and Merrill Lynch (Singapore) (Company Registration Nos F 06872E and 198602883D respectively). MLIBLMB and Merrill Lynch (Singapore) are regulated by MAS. Bank of America N.A., Australian Branch (ARBN 064 874 531), AFS License 412901 (BANA Australia) and Merrill Lynch Equities (Australia) Limited (ABN 65 006 276 795), AFS License 235132 (MLEA) distribute this report in Australia only to 'Wholesale' clients as defined by s.761G of the Corporations Act 2001. With the exception of BANA Australia, neither MLEA nor any of its affiliates involved in preparing this research report is an Authorised Deposit-Taking Institution under the Banking Act 1959 nor regulated by the Australian Prudential Regulation Authority. No approval is required for publication or distribution of this report in Brazil and its local distribution is by Merrill Lynch (Brazil) in accordance with applicable regulations. Merrill Lynch (DIFC) is authorized and regulated by the DFSA. Research reports prepared and issued by Merrill Lynch (DIFC) are done so in accordance with the requirements of the DFSA conduct of business rules. Bank of America Merrill Lynch International Limited, Frankfurt Branch (BAMLI Frankfurt) distributes this report in Germany and is regulated by BaFin.
This research report has been prepared and issued by MLPF&S and/or one or more of its non-US affiliates. MLPF&S is the distributor of this research report in the US and accepts full responsibility for research reports of its non-US affiliates distributed to MLPF&S clients in the US. Any US person receiving this research report and wishing to effect any transaction in any security discussed in the report should do so through MLPF&S and not such foreign affiliates. Hong Kong recipients of this research report should contact Merrill Lynch (Asia Pacific) Limited in respect of any matters relating to dealing in securities or provision of specific advice on securities or any other matters arising from, or in connection with, this report. Singapore recipients of this research report should contact Merrill Lynch International Bank Limited (Merchant Bank) and/or Merrill Lynch (Singapore) Pte Ltd in respect of any matters arising from, or in connection with, this research report.
General Investment Related Disclosures:
Taiwan Readers: Neither the information nor any opinion expressed herein constitutes an offer or a solicitation of an offer to transact in any securities or other financial instrument. No part of this report may be used or reproduced or quoted in any manner whatsoever in Taiwan by the press or any other person without the express written consent of BofA Merrill Lynch.
This research report provides general information only, and has been prepared for, and is intended for general distribution to, BofA Merrill Lynch clients. Neither the information nor any opinion expressed constitutes an offer or an invitation to make an offer, to buy or sell any securities or other financial instrument or any derivative related to such securities or instruments (e.g., options, futures, warrants, and contracts for differences). This report is not intended to provide personal investment advice and it does not take into account the specific investment objectives, financial situation and the particular needs of, and is not directed to, any specific person(s). This report and its content do not constitute, and should not be considered to constitute, investment advice for purposes of ERISA, the US tax code, the Investment Advisers Act or otherwise. Investors should seek financial advice regarding the appropriateness of investing in financial instruments and implementing investment strategies discussed or recommended in this report and should understand that statements regarding future prospects may not be realized. Any decision to purchase or subscribe for securities in any offering must be based solely on existing public information on such security or the information in the prospectus or other offering document issued in connection with such offering, and not on this report.
Securities and other financial instruments discussed in this report, or recommended, offered or sold by Merrill Lynch, are not insured by the Federal Deposit Insurance Corporation and are not

deposits or other obligations of any insured depository institution (including, Bank of America, N.A.). Investments in general and, derivatives, in particular, involve numerous risks, including, among others, market risk, counterparty default risk and liquidity risk. No security, financial instrument or derivative is suitable for all investors. In some cases, securities and other financial instruments may be difficult to value or sell and reliable information about the value or risks related to the security or financial instrument may be difficult to obtain. Investors should note that income from such securities and other financial instruments, if any, may fluctuate and that price or value of such securities and instruments may rise or fall and, in some cases, investors may lose their entire principal investment. Past performance is not necessarily a guide to future performance. Levels and basis for taxation may change.

Futures and options are not appropriate for all investors. Such financial instruments may expire worthless. Before investing in futures or options, clients must receive the appropriate risk disclosure documents. Investment strategies explained in this report may not be appropriate at all times. Costs of such strategies do not include commission or margin expenses.

BofA Merrill Lynch is aware that the implementation of the ideas expressed in this report may depend upon an investor's ability to "short" securities or other financial instruments and that such action may be limited by regulations prohibiting or restricting "shortselling" in many jurisdictions. Investors are urged to seek advice regarding the applicability of such regulations prior to executing any short idea contained in this report.

Foreign currency rates of exchange may adversely affect the value, price or income of any security or financial instrument mentioned in this report. Investors in such securities and instruments effectively assume currency risk.

UK Readers: The protections provided by the U.K. regulatory regime, including the Financial Services Scheme, do not apply in general to business coordinated by BofA Merrill Lynch entities located outside of the United Kingdom. BofA Merrill Lynch Global Research policies relating to conflicts of interest are described at http://go.bofa.com/coi.

MLPF&S or one of its affiliates is a regular issuer of traded financial instruments linked to securities that may have been recommended in this report. MLPF&S or one of its affiliates may, at any time, hold a trading position (long or short) in the securities and financial instruments discussed in this report.

BofA Merrill Lynch, through business units other than BofA Merrill Lynch Global Research, may have issued and may in the future issue trading ideas or recommendations that are inconsistent with, and reach different conclusions from, the information presented in this report. Such ideas or recommendations reflect the different time frames, assumptions, views and analytical methods of the persons who prepared them, and BofA Merrill Lynch is under no obligation to ensure that such other trading ideas or recommendations are brought to the attention of any recipient of this report.

In the event that the recipient received this report pursuant to a contract between the recipient and MLPF&S for the provision of research services for a separate fee, and in connection therewith MLPF&S may be deemed to be acting as an investment adviser, such status relates, if at all, solely to the person with whom MLPF&S has contracted directly and does not extend beyond the delivery of this report (unless otherwise agreed specifically in writing by MLPF&S). If such recipient uses the services of MLPF&S in connection with the sale or purchase of a security referred to herein, MLPF&S may act as principal for its own account or as agent for another person. MLPF&S is and continues to act solely as a broker-dealer in connection with the execution of any transactions, including transactions in any securities mentioned in this report.

Copyright and General Information regarding Research Reports:

Materials prepared by BofA Merrill Lynch Global Research personnel are based on public information. Facts and views presented in this material have not been reviewed by, and may not reflect information known to, professionals in other business areas of BofA Merrill Lynch, including investment banking personnel. BofA Merrill Lynch has established information barriers between BofA Merrill Lynch Global Research and certain business groups. As a result, BofA Merrill Lynch does not disclose certain client relationships with, or compensation received from, such issuers in research reports. To the extent this report discusses any legal proceeding or issues, it has not been prepared as nor is it intended to express any legal conclusion, opinion or advice. Investors should consult their own legal advisers as to issues of law relating to the subject matter of this report. BofA Merrill Lynch Global Research personnel's knowledge of legal proceedings in which any BofA Merrill Lynch entity and/or its directors, officers and employees may be plaintiffs, defendants, co-defendants or co-plaintiffs with or involving issuers mentioned in this report is based on public information. Facts and views presented in this material that relate to any such proceedings have not been reviewed by, discussed with, and may not reflect information known to, professionals in other business areas of BofA Merrill Lynch in connection with the legal proceedings or matters relevant to such proceedings.

This report has been prepared independently of any issuer of securities mentioned herein and not in connection with any proposed offering of securities or as agent of any issuer of any securities. None of MLPF&S, any of its affiliates or their research analysts has any authority whatsoever to make any representation or warranty on behalf of the issuer(s). BofA Merrill Lynch Global Research policy prohibits research personnel from disclosing a recommendation, investment rating, or investment thesis for review by an issuer prior to the publication of a research report containing such rating, recommendation or investment thesis.

Any information relating to the tax status of financial instruments discussed herein is not intended to provide tax advice or to be used by anyone to provide tax advice. Investors are urged to seek tax advice based on their particular circumstances from an independent tax professional.

The information herein (other than disclosure information relating to BofA Merrill Lynch and its affiliates) was obtained from various sources and we do not guarantee its accuracy. This report may contain links to third-party websites. BofA Merrill Lynch is not responsible for the content of any third-party website or any linked content contained in a third-party website. Content contained on such third-party websites is not part of this report and is not incorporated by reference into this report. The inclusion of a link in this report does not imply any endorsement by or any affiliation with BofA Merrill Lynch. Access to any third-party website is at your own risk, and you should always review the terms and privacy policies at third-party websites before submitting any personal information to them. BofA Merrill Lynch is not responsible for such terms and privacy policies and expressly disclaims any liability for them.

All opinions, projections and estimates constitute the judgment of the author as of the date of the report and are subject to change without notice. Prices also are subject to change without notice. BofA Merrill Lynch is under no obligation to update this report and BofA Merrill Lynch's ability to publish research on the subject issuer(s) in the future is subject to applicable quiet periods. You should therefore assume that BofA Merrill Lynch will not update any fact, circumstance or opinion contained in this report.

Certain outstanding reports may contain discussions and/or investment opinions relating to securities, financial instruments and/or issuers that are no longer current. Always refer to the most recent research report relating to an issuer prior to making an investment decision.

In some cases, an issuer may be classified as Restricted or may be Under Review or Extended Review. In each case, investors should consider any investment opinion relating to such issuer (or its security and/or financial instruments) to be suspended or withdrawn and should not rely on the analyses and investment opinion(s) pertaining to such issuer (or its securities and/or financial instruments) nor should the analyses or opinion(s) be considered a solicitation of any kind. Sales persons and financial advisors affiliated with MLPF&S or any of its affiliates may not solicit purchases of securities or financial instruments that are Restricted or Under Review and may only solicit securities under Extended Review in accordance with firm policies.

Neither BofA Merrill Lynch nor any officer or employee of BofA Merrill Lynch accepts any liability whatsoever for any direct, indirect or consequential damages or losses arising from any use of this report or its contents.