PRICE Asset Management
Commodities & Managed Futures

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Commodities: An Explanation of Returns (Part 1)

In our February Investment Commentary, we highlighted the fact that not all commodity indices are created equal, and that methodology differences among seemingly generic commodity strategies are responsible for the wide dispersions in observed results. We cited the example of the Rogers International Commodity Index®, tracing the story of its development by Jim Rogers as a factor-based approach to commodity portfolio construction, and demonstrated the total return advantages of rules-based enhancements. We established that 6 discrete variables are the mechanical drivers of returns (selection, weighting, roll calendar, contract tenor, rebalancing frequency, and collateral choice). In this discussion we will do a deep dive into the sources and interrelationships of the commodity returns themselves.

We're Not in the Commodities Business

Investors in commodities assume that when physical (spot) commodity prices go up they will earn money in their commodity fund investments, and this is normally the case. Investors may occasionally find, though, that their fund's participation can lag when prices rise, and possibly even earn positive returns when commodity prices modestly decline. This is because, due to the practical limitations of investing in physical commodities, investment managers are typically using the exchange traded futures market or its swap proxy. Virtually all published commodity indices, commodity mutual funds, and ETFs are futures-based, as this has proven by far to be the least expensive, most liquid, and most expedient way to gain broad commodities exposure. But the use of futures brings additional important pricing influences that, at times, may deliver a counterintuitive outcome. Futures also offer valuable additional return opportunities that don't exist in the physical commodities markets. Because of this, though, it's important to understand the business that commodities managers are really in. We're not in the business of owning physical commodities changing hands at the spot price; we're in the *risk capital business*. By utilizing futures contracts, investors are actually participating in the pricing of a nexus of intermediation activities (hedging, storage, transportation, insurance, financing, loss, etc.) that take place in the futures markets, the *expected* costs of which are reconciled daily in *forward price* form. Purchasing (long) commodity futures contracts represents a provision of risk capital to other market participants that is not the same thing as owning commodities.

Since futures positions must be reestablished (rolled) every few weeks to avoid expiration or delivery, and trade at prices that are usually different from the spot price, investors in futures like to compare the futures returns to the movement of spot prices. Both spot and futures prices are extremely transparent, so it's easy to see the daily performance of both. Establishing a futures position also only requires posting a margin which is a fraction of the underlying commodity value, so the majority of the notional investment amount represents

cash available for additional investment, the returns of which are also easy to track. The combination of these 3 return elements form the basis for an attribution framework: *spot return* (the price at which physical commodities trade daily), *"roll yield"* (the benefit or drag on performance of substituting futures for physical), and *collateral return* (the return on the remaining cash not used for margin purposes). This was the earliest method of describing returns, because the math is straightforward, and we still frequently see commodity managers break out returns this way. Unfortunately, the simple spot+roll+collateral calculation tends to obscure important sources of commodities returns. In particular, it tells us nothing about *where the futures portion of the returns came from*, only how they compare to the price of physical commodities.

The practice of observing spot price markets can be a bit contradictory, since they don't represent the prices of the investments we actually own (futures and cash). Tracking spot prices can also be very misleading, and there are no investible spot price indices representing commodities *beta*.*. Spot prices in commodities represent the prices at which physical commodities change hands *today,* but don't include any additional subsequent holding costs that accrue to the purchaser immediately post-purchase. Unless investors also happen to have an industrial commodities business on the side, they *can't invest at the spot price* without paying for the actual commodities in full, in bulk minimum amounts, plus the costs of storage, insurance, financing, transportation, spoilage, etc. So, unlike stocks or bonds, where every index constituent can fairly easily be purchased and held, physical commodities can be difficult or impossible to take possession of. Of course, there are embedded costs associated with purchasing all investments, but in the case of stocks and bonds they're de minimis, especially so in the current low interest rate environment. Not so with commodities, as the costs are significant, and their impact on the shape of the forward curve (the term structure of futures prices) is profound.

We believe one reason investors compare spot prices to futures prices is because they don't really understand the futures curve, are concerned about possible implementation costs embedded in it, and want to determine what these are. So, let's examine the forces acting on the forward curve, the computation of its return contribution *(roll yield),* and compare futures performance to that of physical commodities.

The Forward Curve is Misunderstood

Futures prices are, simply, spot prices combined with assumptions (with varying degrees of certainty) about the forces that will act on prices in the future (the farther down the road, the less certain or accurate the assumptions will be). The result is a series of futures contract expirations that trade at prices that are different, either up or down, from the current spot price. If the prices along the curve are steadily higher (i.e.,

*So how do we define commodities *beta*? We use futures-based indices. Two indices have been generally adopted by the industry as the benchmarks for performance measurement: the Bloomberg Commodity Index (formerly Dow Jones UBS CI), and the S&P GSCI.

the price of a contract expiring in 6 months is more expensive than the price for the contract expiring in 3 months), we refer to the shape of that curve as being in *contango.* If the opposite is true, that prices decline along the curve, it's referred to as *backwardation*. (Sometimes forward curves exhibit both of these conditions at the same time, at different points along the curve). Although this seems pretty straightforward, most of the misunderstanding centers around *implications of the forward curve on future price expectations.*

Let's start with correcting a common misunderstanding. *The forward curve is not a price discovery mechanism.* That fact that even the pundits get this wrong can be excused a bit, because it seems intuitive: dealing in futures guarantees the price you will pay in the future, and why else would an investor do it if that wasn't assumed to be the correct future spot price? To add to the confusion, in the long run, the shapes of futures curves may actually exhibit some positive correlation to the future direction of prices (explained later). But, at the risk of oversimplification, it's best to view this as a coincidence. Although activity around expected price assumptions inherently works its way into futures prices, the forward curve is a very unreliable predictor of future prices. Unfortunately, like every other security, if you want to know what a commodity price will be a year from now, you'll have to wait a year to find out. For example, let's assume that WTI Crude Oil is approximately $38/bbl in the spot market (or nearby futures contract) and $46/bbl in the contract expiring one year later. This is *not* telling us that the spot price of oil will be $46 a year from now, or even that investors think it will be. It certainly isn't telling us to buy crude today at $38 and wait a year for it to move to $46! It merely suggests that, calculating the effect of all anticipated forces on pricing, traders have agreed that they're mathematically indifferent about either of those prices, given what they know *today*. One way to think of this is that, to the market, $38 today and $46 in one year are *prices that have the same expected outcome.* Keep in mind also that various market participants are using the futures markets for different purposes, at different times, in different directions, at different points along the curve, with different holding periods, and most important, with different assumptions regarding expected price influences in the future. Undoubtedly they get this last part wrong, frequently. But, essentially, a snapshot of the futures curve at any time is simply a list of delayed-delivery transaction prices where an equilibrium of market forces, *known and unknown*, has settled.

Embedded in forward curve pricing are 3 basic influences on it, with opposing effects on the shape of the curve: *cost of carry, convenience yield, and risk premium.*

Cost of carry refers to the costs of owning a physical commodity, as noted earlier. The effect of carry costs on the forward curve is also the easiest one to identify, since these costs are relatively quantifiable. When the cost of carry is expressed along the forward curve, the prices at each point in the future will be steadily higher because the holding costs keep accruing. This results in an upward sloping curve, a condition called *contango*. It's the primary rationale for the price difference between physical commodity and futures prices, and it's viewed as a *normal* curve condition. If 100% of the assumed costs of carry are expressed in the forward curve,

it's referred to as a full carry curve. Using the Crude Oil example above, if the forward curve was reflecting the full cost of carry, then the combined costs of owning a barrel of oil over a 1 year period are assumed to be about $0.67/bbl per month, or $8/bbl. Again, this has nothing to do with what the price of oil will be a year from now. But we do know that if we buy physical crude oil today at $38, and the carry costs remain constant, we need to sell it at more than $46 a year from now to earn a profit.

Convenience yield describes the effect on the forward curve when there is an economic advantage or tangible benefit to holding physical commodities sooner rather than later. It influences prices toward *backwardation*, with spot and nearby futures prices higher than those farther along the curve, because the price of the nearby contract reflects an acute demand condition, and also that this condition is viewed as temporary. (If demand was considered more permanent, then prices at every point along the curve would be expected to rise, not just the nearby ones). In our Crude Oil example, if oil demand suddenly increased or reported inventories suddenly declined, the curve could look like $54/bbl in the nearby contract and $46/bbl one year forward. A backwardated curve is referred to as *inverted* because it's viewed as an abnormal condition of the market, however many commodities are frequently in backwardation, especially when viewed seasonally.

Risk (or insurance) premium refers to the difference between today's price of a futures contract and the spot price at that contract's expiration in the future (net of other pricing influences). Remember that as commodities futures buyers, we're in the business of providing risk capital to other market participants, in this case primarily commodity producers. When producers wish to separate their business risks (certain) from market risks (uncertain) they may sell their commodity production in advance using the futures markets, *if* the price of the futures contract means they'll be locking in a profit. They may do this even though they believe that *the price they are selling at for future delivery is lower than the price they might have sold at on that date.* They have decided that the certainty of profit is worth more than the possible opportunity to earn more by waiting, and that the difference in price is worth the risk reduction it offers. The buyer of futures, then, collects the difference in price between the futures price and the future forward spot price (in practice, this is observed more as convergence toward expiration, since futures investors do not wait until delivery to deal at the spot price). The difference between those prices is the insurance premium that accrues to futures investors because they are positioned in that risk capital business.

This premium, central to the risk transfer function of futures markets, was identified by Keynes as early as 1930. To make things really confusing, he labeled it *normal backwardation*, which is not to be confused with backwardation, but very often is. *Normal backwardation exists in all curve conditions*, not just backwardated markets (although its influence on the curve is in the direction of backwardation). In other words, a commodity investor (long investor) gets paid for allowing a commodity producer (short hedger) to externalize short-term price risk and they get paid during almost all market conditions to do this. Right away, the claim

on premiums from this activity more resembles an insurance policy than the commodity speculation business, and it's a very consistent source of commodity returns quite separate from other influences on prices. The risk premium phenomenon is generally considered to be specifically unobservable, but we know it exists due to the costs structures of producers (hedgers) vs. processors, consumers, or speculators.*

Roll Yield is Counterintuitive

In keeping with the simplified attribution calculation we used earlier (spot + roll yield + collateral), roll yield, positive or negative, refers to the measurement of the futures portion of returns, net of spot price movement. Since futures must be sold before they expire, then replaced with the next and longer contract position (rolled), roll yield is the difference between the price of the contract that was sold and the replacement cost of the new contract, after deducting the price movement that the physical commodity (spot price) exhibited over the same period of time. If futures positions are consistently rolled from a lower price to a higher price (a curve exhibiting contango), this will cost the investor money, and it's referred to as negative roll yield. Conversely, if futures contracts are rolled into steadily lower prices (a backwardated curve), the investor will earn a positive roll yield.

Roll yield is essentially an implementation cost (or benefit) of owning commodities futures, and it receives an inordinate amount of attention. It's visible, easy to calculate, its impact seems intuitive, and it's the first thing novice commodity investors seem to focus on. It's absolutely true that contango will cost an investor and backwardation will benefit an investor, *strictly in roll yield terms*. It would seem obvious that an investor could maximize roll yield by simply avoiding commodities in contango, and limiting positions to only those in backwardation. However, focusing on implementation mechanics in isolation distorts the true total return expectation, as it would in any market. It actually makes no more sense to avoid commodities in contango than it does to avoid no-dividend equities, simply because they "cost" more to own, or to avoid shorting high-yield debt due to the negative carry costs associated with borrowing bonds. In 2007, buying protection on sub-prime mortgage CDOs using credit default swaps was very expensive, continuously so, right up until it paid 100:1! Earlier this year, Crude Oil experienced one of its steepest (most expensive) curve conditions in history, right before it subsequently rallied by over 75%. The lesson learned is, unless the costs are truly prohibitive, *implementation factors should never drive positioning decisions.* Here's why it's especially true of commodities.

*Although rare, there are examples (notably Natural Gas) of *negative* normal backwardation. In this situation, the pricing influences of producer and buyer are reversed. If the buyer (a utility, for instance) is the party seeking forward price certainty, then they may be willing to pay *more* than the theoretical future spot price, in this case to guarantee supply at a price they know they can afford today. Note that this is still independent from the shape of the curve in general.

Commodities exhibiting steep contango (full cost of carry) are doing so because they are plentiful, perhaps over-produced, widely stored, and readily available. This implies that current prices are *lower* than they might be in the future (which can account for the interpretation of the steeper forward curve as predictive of a higher expected future price). The opposite is true of backwardation, evidencing convenience yield. Users needs the commodity now, not later, and accordingly it may be priced more dearly in the spot and nearby futures marketplace due to a near-term, but acute, demand condition. The problem with investing solely around implementation concerns is that it puts an investor on the *opposite side of subsequent supply and demand corrections.* In other words, negative roll yield (contango) is frequently observed when a commodity is *cheaply priced*, and correlated with higher commodity prices in the future. Positive roll yield (backwardation) may mean a commodity is temporarily overpriced, implying lower prices later. This is why trailing returns have a counterintuitive relationship with roll yield, and why a strategy of owning only backwardated commodities and avoiding (or shorting) those in contango does not work over an extended period of time.

Another misunderstanding has to do with the concept of roll yield itself. Isolating roll yield as a return input has led, incorrectly, to the idea that it can be identified *in advance*, like a bond yield. Inevitably, this leads to the belief that it can and should be actively managed. The problem with active curve management is that it starts out based on inverted causality: roll yield doesn't deliver an assumed return, the return experience determines what the roll yield was, after the fact. It's a measurement of historical returns, not forward returns, because roll yield is unknown until the next futures positions are rolled. Remember, the shape of the forward curve does not forecast future prices, and only the shape of *today's* forward curve is known. The next roll occurs in the context of the shape of the curve in the future, and until the original position is unwound and rolled into the new one, this will always be unknown. Therefore, it is impossible to determine roll yield in advance, so position decisions are based on assumptions of *future curve conditions.* Those assumptions are just as problematic as any other active investment management decision. In commodities, supply and demand equilibrate over time, and prices tend to eventually mean revert. As a consequence, curves are dynamic, and contango will at some point flatten and shift into backwardation, and vice versa. This is very difficult to anticipate with any accuracy. Investors are forced to observe today's curve, determine its propensity to deviate in the future, and decide how to position. The only thing a manager knows with certainty is that the curve in the future will not be the same as the curve today.

Finally, there's an asymmetry to the possible shapes of forward curves that actually works in the investor's favor. This is because *contango is limited to being no steeper than the forward costs of carry embedded in it*, and this makes perfect sense. If the price of a commodity in the futures market exceeds it spot price plus the full costs of owning it for that same period, then an arbitrage opportunity presents itself. A market participant could simply sell the overvalued forward contract, buy the physical commodity, pay the carry costs, and pocket the difference. Unlike contango, backwardation is theoretically unlimited. Perfecting a backwardation

arbitrage would mean borrowing a commodity today to sell into the spot market, and buying the longer dated futures contract, earning the difference. Unfortunately, a reverse repo market in commodities doesn't really exist. As a result, observed backwardation can be very steep, and only tempered by the level of acute demand and the ability of producers to meet it. All of this leads to the conclusion that investors earn returns owning commodities in contango due to an eventual price correction higher, but not without some implementation costs, which are *limited by arbitrage* to only the full cost of carry. Conversely, investors earn returns owning commodities in backwardation due to the positive roll yield, which is *unlimited*, but may lose money on a subsequent correction to lower prices. The most important take-away from all of this is the understanding that arbitrage prevents prices on the forward curve from exceeding the full costs of owning physical commodities. This means that, over the same time periods, *investing in commodity futures is not more expensive than holding physical commodities.*

Diversification Returns

An important return source not accounted for in the simple attribution analysis accrues from an interesting attribute of commodities. A commodities portfolio is really a group of unrelated raw material goods. They are the products of very different industries that would normally not occupy the same index. The market dynamics of milk or soybeans have little to do with those of gasoline or platinum, because their return drivers are different. Commodities that are seemingly related, like Crude Oil and Natural Gas, display less correlation than we would expect, but the price behavior is even more idiosyncratic when comparing different commodity sectors (industrial metals vs. grains, for instance). As a result, even though they are all generically "commodities," they are typically not well correlated to each other. Individual commodities can also exhibit fairly high, equity-like volatility, but tend to mean revert fairly predictably over market cycles as supply and demand equilibrate. This creates an opportunity that is peculiar to the commodity asset class. Combining assets with low correlations and high volatility that also mean revert regularly is an opportunity to harvest additional returns through rebalancing. Rebalancing a group of commodity constituents, then, becomes a return source distinct from the movement of single commodity prices in isolation. The frequency with which they are rebalanced is one of the portfolio management variables we noted earlier.

The higher significance of rebalancing as a return source is unique to commodities. As discussed in our previous Investment Commentary (February 2016), rebalancing would not be expected to add much value to an index composed of high populations of constituents with high correlations, like broad equity or fixed income indices, and it doesn't. But, in the case of commodities it can be a very important contributor to total return. It is also somewhat controversial. There have been a number of studies performed on commodities portfolios to determine the effects of more frequent rebalancing, or if rebalancing should be performed at all, and they are inconclusive. Rebalancing is really nothing more than the practice of selling temporarily well-performing assets and adding to temporarily under-performing assets, according to a pre-determined

weighting scheme. It follows that the recipe to maximize this would be higher volatility, lower cross-correlations, and as many constituents (opportunities) as possible. It is also true, however, that rebalancing involves readjusting commodities weightings *away from* the direction of the immediate previous performance (the opposite of trend following). During strongly trending markets it might penalize performance by taking winning positions off of the table prematurely.

Since the return outcome of rebalancing strategies is somewhat dependent on the degree to which markets are trending or not, the results of the studies will vary due to the selection effect of the time interval in question. Regardless, the results of most of the studies would seem to side with rebalancing, given the overall mean reversion that commodities display. One study has gone as far to say that rebalancing accounts for virtually all the return in a commodities portfolio *(Erb and Harvey 2006)*, but is silent on the premium above the risk free rate that indices that don't rebalance have also earned. Finally, an important benefit of regular rebalancing is that it *replenishes* diversification, with a corresponding reduction in portfolio volatility.

Inflation, Event Risk, and Other Surprises

One of the more interesting features of commodities is their ability to immediately capture the changes in expected future prices that arise from exogenous events that may occur without warning. For this reason, commodities are often cited for their inflation or event risk hedging benefits to the broad portfolio, a portfolio that generally consists mostly of stocks and bonds that may have a deleterious reaction to those same events. Unanticipated events can be unique return drivers because they can create distortions in pricing that are separate from the normal factors that influence forward prices. In the case of commodities, surprises such as *unexpected* inflation can cause futures prices to be revalued higher (commodities are measured in currencies and are sensitive to devaluation). Weather, natural disasters, geopolitical crises, terrorism, even the threat of local epidemics can create real or perceived disruptions in production and distribution that are almost always interpreted as positive for commodity prices. Commodities likely exhibit *positive skewness* for this reason.

In Part 2 of our Investment Commentary, we will examine why a more comprehensive attribution analysis is so difficult, but also why it is so important to our understanding of how to build superior commodities portfolios.

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