Two Types of Systematic Returns Available in the Commodity Futures Markets

One particular type of systematic commodity investing has successfully made it into the mainstream. Investments based on the production-weighted Goldman Sachs Commodity Index (GSCI) have attracted significant capital. This is because there are well-documented arguments for why this index should have positive returns. What is less well known is that the commodity futures markets offer additional systematic return opportunities besides what is available in a GSCI-based investment. This article discusses the return opportunities available in both a GSCI-type investment and in a commodity program entirely independent of the GSCI.

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Rationale for Systematic Returns in a Passive, Long-Only Commodity Program

Institutional investors have been persuaded to invest in GSCI-based programs because of well-documented arguments on why there should be positive returns to this type of program. As one delves into why these systematic returns should exist, one finds that these returns are concentrated in particular commodities. Since the GSCI is heavily weighted in those commodities, it historically has had positive returns as will be explained below.

The particular commodity futures contracts which have statistically significant returns are ones whose underlying commodity have difficult storage situations. For these commodities, either storage is impossible, prohibitively expensive, or producers decide it is much cheaper to leave the commodity in the ground than store above ground.

The existence of storage can act as a dampener on price volatility since it provides an additional lever with which to balance supply and demand. If there is too much of a commodity relative to demand, it can be stored. In that case, one does not need to rely solely on the adjustment of price to encourage the placement of the commodity. If too little of a commodity is produced, one can draw on storage; price does not need to ration demand.

Now, for commodities with difficult storage situations, price has to do a lot (or all) of the work of equilibrating supply and demand, leading to very volatile spot commodity prices. A defining feature of commodities is the long lead-time between deciding on a production decision and the actual production of the commodity. It is impossible to exactly foresee what demand will be by the time a commodity is produced. This is why supply and demand will frequently not be in balance, leading to large price volatility for a number of commodities.

Producers and holders of commodity inventories will therefore turn to the commodity futures markets to control or manage uncertain forward price risk. The price pressure resulting from commercial hedging activity causes a commodity's futures price to become biased downward relative to its future expected spot rate. In that situation, a long commodity futures position will have a positive expected return.

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Kolb [1996] effectively verifies these arguments in an empirical study. Kolb examined 45 commodity futures contracts over the timeframe 1969 to 1992 and determined which commodities have statistically significant daily returns using both parametric and non-parametric tests. If a contract did not exist as of 1969, Kolb starts calculating a contract's return series at its inception. Of the non-financial futures contracts, the only commodities which had significant positive returns under both tests were crude oil[1] , gasoline, live cattle, live hogs, soymeal, and copper. To a contract, each of these commodities has a difficult storage situation. Table 1 below shows the calculated returns of each contract.

Various authors have confirmed that each of the six commodities listed in Table 1 have "difficult storage situations."

Regarding soybean meal and livestock, Schwager [1995] noted:

Table 1. Futures Returns from 1969 - 1992 (or contract inceptions)

Commodity	Mean Return (Percent per Year)	t-Statistic	Wilcoxon Signed-Rank Test
Soybean Meal	7.97%	2.87	-2.58
Live Cattle	7.33%	4.35	-4.22
Live Hogs	11.74%	4.04	-3.57
Crude Oil	7.79%	1.69	-2.39
Unleaded Gas	16.40%	3.30	-4.09
Copper	11.15%	3.17	-2.56

These returns exclude returns from one's collateral investments.

Source: This table is an excerpt from a table in Kolb's paper.

"Ending stocks are the key fundamental factor for soybeans and [soybean] oil, but since soybean meal is not storable, ending stocks of meal tend to be equal to only a few days of supply and are not a meaningful figure. Soybean meal also differs from soybeans and oil in that all production must be sold regardless of price. Hence, in the case of soybean meal, consumption is almost entirely a function of supply, not demand. In this context, soybean meal is similar to other non-storable commodities, such as hogs and cattle, which must be marketed soon after they reach market weight, regardless of price."

Regarding the petroleum complex, Rowland [1997] explained:

"From wellheads around the globe to burner tips, the world's oil stocks tie up enormous amounts of oil and capital. The volume of oil has been estimated at some 7-8 billion barrels of inventory, which is the equivalent of over 100 days of global oil output or 2.5 years of production from Saudi Arabia, the world's largest producer and exporter of crude oil. Even at today's low interest rates, annual financial carrying costs tied up in holding these stocks amount to around $10-billion, which is more than the entire net income of the Royal Dutch/Shell Group, the largest private oil company in the world."

Table 2. GSCI Returns from 12/31/86 - 12/31/99

Index	Per Annum Returns	Year 2000 GSCI Weights
GSCI Total Return Index	9.37%	
GSCI Industrial Metals Sector	16.20%	8.8%
GSCI Energy Sector	11.75%	59.7%
GSCI Livestock Sector	8.70%	10.4%
GSCI Agriculture Sector	2.45%	18.5%
GSCI Precious Metals Sector	-1.30%	2.6%

Returns include the returns from fully collateralizing one's futures investment with 3-month T-bills. Time Period: 12/31/86 to 12/31/99. Data Source: Bloomberg

Source of Year 2000 GSCI weights: Chicago Mercantile Exchange

In language similar to Rowland, Keynes [1935] also discussed various commodity inventories, including copper, whose aggregate value is "an enormous sum on which to find persons willing to run the risk of price changes." The situation for copper is aggravated by the fact that "copper is produced under conditions of very variable return."

Either because the commodity is non-storable or because the commodity is prohibitively expensive to store, the previously mentioned commodities each have "difficult storage situations".

Except for soybean meal, each of the six commodities in Table 1 is in the GSCI. Using this year's GSCI weights, these commodities collectively make up 56.2% of the index, which means the GSCI is majority-weighted in commodity futures contracts that historically have had systematic returns.

One might expect that the bulk of the GSCI's returns would be due to its weightings in commodities with difficult storage situations. This would be a reasonable expectation since the empirical evidence of returns is strongest for these commodities. The theoretical explanation for returns is also the most compelling for these commodities. And in fact (as shown in Table 2) a historical decomposition of the GSCI's returns shows that the bulk are due to its energy, industrial metal, and livestock sectors. These three sectors include commodities which have difficult storage situations. The excluded sectors, the agricultural and precious metals sectors, on the other hand, are negligible to negative return contributors. This is as expected, given that these two sectors represent commodities which generally do not have "difficult storage situations".

By taking long positions in the particular commodity futures contracts where significant commercial hedging pressure is noted (or in indices which are heavily weighted in these commodities), one is earning a risk premium as defined by Chang [1985]:

"The term 'risk premium' generally refers to an average reward to investors for being willing to assume a risk position in a risk-averse financial world. The reward in this form should not be conditioned on any superior judgment or inside information."

In other words, one can earn systematic returns through a passive investment in these commodity futures contracts (or in an investment heavily weighted in these commodities.)[2]

Another Source of Systematic Returns in the Commodity Futures Markets

Are there other sources of risk premia in commodity futures markets? The short answer is yes. What Jacobs and Levy [1989] noted for the stock market is equally true for commodity futures markets:

"The stock market … is a complex system. … The market is permeated by a web of interrelated return effects. "

Taking a position on the other side of commercial hedging pressure is only one source of return in the commodity futures markets. As a matter of fact, the trade is well aware of another source of systematic returns. As Cootner [1967] notes, this does not prevent return regularities from reoccurring:

" ... it is quite clear that members of … the … grain trade are quite aware of … seasonals. The fact that these seasonals persist in the face of such knowledge indicates that the risks involved in taking advantage of them outweigh the gain involved. This is further evidence that the trade does not act on the basis of expected values; that it is willing to pay premiums to avoid risk."

Another source of systematic returns in the futures markets are "weather premia" trades. In this class of trades, Till [2000] explains:

"A futures price will sometimes embed a fear premium due to upcoming, meaningful weather events [that can dramatically impact the supply or demand of a commodity.] One cannot predict the weather, but one can predict how people will systematically respond to upcoming weather uncertainty.

In this class of trades, a futures price is systematically too high, reflecting the uncertainty of an upcoming weather event. We say the price is too high when an analysis of historical data shows that one can make statistically significant profits from being short the commodity futures contract during the relevant time period. And further that the systematic profits from the strategy are sufficiently high that they compensate for the infrequent large losses that occur when the feared, extreme weather event does in fact occur."

These trades can be mechanically executed similar to a passive commodity index and are another way to earn a risk premium. These trades are concentrated in markets which do not exhibit significant returns from commercial hedging pressure. These trades can be found in the grain, tropical, natural gas, and cotton futures markets during particular times of the year.

In what follows, we will discuss the rationale for why these trades exist, examples of how the trade is well aware of the return opportunities, and lastly the historical returns from mechanically implementing these trades.

Grains

A 5/2/00 Refco[3] commentary notes that:

"The grain markets will always assume the worst when it comes to real or perceived threats to the food supply."

The result is that coming into the US growing season, grain futures prices will systematically have a "weather premium" added into the fair-value price of the contract. The fact that this premium can be easily washed out if no adverse weather occurs is well known by the trade. Notes a 5/2/00 Salomon Smith Barney[4] commentary:

"The bottom line is, any threat of ridging this summer will spur concerns of yield penalties. That means the market is likely to keep some weather premium built into the price of key markets. The higher the markets go near term, the more risk there will be to the downside if and when good rains fall."

Other commentaries also refer to the need to "keep some weather premium built" into grain prices before key pollination periods:

"… the key pollination period will extend into the second and possibly the third week of July. … July is still going to be the critical period for this year's corn crop," notes a 6/14/00 Salomon Smith Barney commentary.

"July corn … is still undervalued this early in the season," said Dan Basse, vice president of AgResource, a Chicago consulting firm. "We have to keep some weather premium in there," [as quoted in the 6/15/00 Wall Street Journal].

"It is conceivable that we have taken too much of the risk premium out of the [corn futures] market with pollination still ahead of us," as suggested in a 6/15/00 Benson-Quinn[5] commentary.

By the end of July, the weather conditions which are critical for corn yield prospects will have already occurred. At that point, if weather conditions are not adverse, the weather premium in corn futures prices will no longer be needed:

"In any weather market there remains the potential for a shift in weather forecasts to immediately shift trends, but it appears as though grains are headed for further losses before the end of the week. With 75% of the corn silking, the market can begin to get comfortable taking some weather premium out," reflects the 7/27/99 Pool Commodity Trading Service[6] Daily Market Commentary.

One might expect that coming into the crucial pollination and reproductive period for corn in mid-July that statistically speaking, corn futures prices would be overvalued, reflecting a built-in weather premium. And also that on average, corn futures prices would sag after passing through the critical weather period, assuming that very adverse weather is a rare event.

To test this idea, we examine the return history of the December corn futures contract from late June until the end of July. Using the convention in Kolb [1996], futures returns are calculated as follows. The return over the trade horizon is calculated as the percentage change in the settlement price from the trade's inception date to its exit date. These returns exclude any returns from investing one's collateral.

Table 3. December Corn Futures Prices

(from about June 25th to the end of July 1980-1999)

Average Returns	= -5.16%
Z-statistic	= -2.37
Maximum Realised Return	= +15.1%
Count	= 20 data points

Table 4. September Coffee Futures

(from about May 20th to about June 25th, 1980-1999)

Average Returns	= -8.25%
Z-statistic	= -4.09
Maximum Realised Return	= +10.25%
Count	= 20 data points

Table 5. September Natural Gas Futures

(from about June 14th to about July 19th, 1990-1999)

Average Returns	= -5.28%
Z-statistic	= -2.32
Maximum Realised Return	= +11.02%
Count	= 10 data points

Tables 3, 4, 5, above: Assuming independence of returns across years and that the returns are at least approximately normally distributed, this set of returns is significantly negative at the 5% level under a one-tailed t-test. This means that it is very unlikely that the preponderance of negative outcome is due to randomness.

Data Source: Bloomberg

These results in Table 3 confirm a historical overpricing of corn futures prices, coming into the key weather uncertainty period for this commodity.

At least historically, the returns indicate that an investor could have generally monetized a risk premium by taking a short position in corn futures contracts during late June until the end of July. This investor is bearing a risk that others do not wish to hold: that of a severe weather occurrence which could adversely affect the supply of a vital grain.

Assuming the continued unpredictability of weather, one may hypothesize that this market will always have a risk premium embedded in its price coming into the month of July.

One can also find the same type of phenomena in the wheat, soybean, and cotton futures markets during their respective key weather uncertainty periods in the US.

Coffee

Like the grains, the uncertainty of weather in Brazil creates a built-in weather premium in coffee futures prices during certain times of the year. As Teweles and Jones [1987] note:

"… because of Brazil's significance as a producer, its susceptibility to frosts and droughts, and its April-to-August harvesting season, the June-July period is subject to volatile, uncertain price movements."

Further, a 5/26/00 Salomon Smith Barney commentary warns that:

"We have commented that an important fundamental consideration is coming up, that is winter in Brazil. It starts on June 21. There have been 17 freezes in the last 100 years with 4 in June, 9 in July, and 4 in August."

Could another "weather premium" trade be to short coffee futures contracts coming into the Brazilian winter? Let us examine the historical data in Table 4.

Again, like the grains, coffee has historically offered weather-premium-related investment opportunities.

Unusually, this commodity offers another weather uncertainty-related opportunity. According to a 10/13/99 Refco commentary:

"Typically, October marks the beginning of the spring rainy season, which normally extends through November and with less intensity, into December and January. At this time, coffee trees enter what is called their first flowering period. During this period the trees need moisture to flower and produce the berries that will ultimately produce the coffee beans on which Brazil production is premised."

Further, a 9/1/99 Salomon Smith Barney Foreign Weather bulletin notes:

"Once the rains begin across the coffee belt [in south central Brazil] during late September or early October, the [coffee] trees begin to flower. The flowering process is a critical period for overall yield prospects for the 'new crop' since any damage during this time frame is irreversible. Thus, the onset of the rainy season is extremely

important for the coffee crop since it determines initial production prospects, either good or bad, for the new crop."

As before, the empirical data supports the existence of a "weather premium" trade where one would short coffee futures contracts coming into the Brazilian spring rainy season.

Natural Gas

For natural gas, starting in July, there is fear of adverse hot weather in the US Northeast and Midwest. Air conditioning demand can skyrocket then, dramatically increasing the demand for natural gas. From June to July, a systematic trade may be to short natural gas futures contracts. Although the data set for natural gas futures is not as long as for the grains and coffee, it appears that there is also a weather premium embedded in the natural gas futures price coming into a key space-conditioning demand period, as shown in Table 5.

The Portfolio Effect

Each weather-premium trade is obviously quite risky. But as long as one is careful about correlations amongst trades, an investment manager can set up diversified commodity portfolios with surprisingly low risk. For example, one can combine long positions in futures contracts where there is detectable commercial hedging pressure with short positions in contracts where there is a built-in weather premium. In our experience, because the factors driving these trades are unrelated, the resulting portfolio is less volatile than the individual trades making up the portfolio. By taking advantage of the portfolio effect on risk, one is able to become a more efficient bearer of risk than others. In other words, one is able to engage in trades that are well known as having a positive expected value, but which others are unwilling to take on because of the individual riskiness of each trade.

Other Systematic Trades

Are there other systematic commodity futures strategies besides ones relying on commercial hedge pressure or a weather premium? Thus far, we have found one other category of systematic trades, which is called the "structural rigidity" strategy. In this class of trades, Till [2000] explains:

"For some commodity markets, there can be such enormous structural rigidities that futures prices have to do a lot of work to encourage certain production choices. These rigidities may be so persistent that a futures price consistently undershoots the level it needs to go to in order for commercial participants to change their behaviour to one required by the overall economy."

Conclusion

This article discusses two classes of commodity futures strategies where one could earn a risk premium through passive investment in mechanically defined programs. Using both theoretical and empirical arguments, we show that there are other sources of systematic returns available in the commodity futures markets besides those associated with a GSCI-type investment ■

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Footnotes

1. For the parametric tests, Kolb's paper uses two-tailed t-tests, examining whether a contract's daily return is significantly different from zero. Crude oil fails this test at the 5% significance level. But, the contract's returns *are* significantly positive when one examines a one-tailed test of the hypothesis that the returns are negative. This latter hypothesis can be rejected at the 5% level. We consider this sufficient evidence to include crude oil as a contract with statistically significant positive returns.
2. In fleshing out the argument for why certain commodity futures contracts should have positive expected value returns, we chose to frame the arguments in non-emotional academic language. Alternatively, one could write as Keynes [1935] did that:
"the violence of the fluctuations which normally affect the prices of many individual commodities shows what a great risk the short-period speculator in commodities runs, for which he requires to be remunerated on a corresponding scale."
Of note is that Keynes was not only a renowned historian and economist, but also an experienced commodity speculator, which we believe explains the added flair of his explanation.
3. Refco is a U.S. Futures Commission Merchant.
4. Salomon Smith Barney is also a U.S. Futures Commission Merchant.
5. Again, Benson-Quinn Commodities, Inc. is a U.S. Futures Commission Merchant.
6. Pool Commodity Trading Service, Inc. is a Canadian Futures Commission Merchant.

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