

Risk Management and Portfolio Construction in a Commodity Futures Programme

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The focus of this article will be on risk management within the context of a total-return futures program centered on commodities. The following issues will be addressed:

- The evaluation of normal versus eventful risk;
- The sizing of trades and strategy buckets; and
- The construction of a portfolio, which takes into consideration these risk and sizing metrics.

We provide examples from three historical portfolios in order to make this discussion concrete and practical.

One way of approaching proprietary futures trading is to determine what economic service each strategy is providing to the market and to understand the risk being assumed by providing that service. *Risk management is perhaps the most important element of a commodity program.* Traditional asset classes rarely experience the type of volatility encountered in commodity markets. For example, the implied and realized volatility for natural gas both exceeded 100% at times in 2006.

The other notable feature of commodity futures markets is that leverage is easy to attain. A futures investment requires very little margin. Some programs require only \$7 for each \$100 of exposure. So traders can easily dial up their leverage to magnify gains and losses. In this environment, risk management is crucial.

We largely view risk management as a product-design issue. One should first decide on the largest acceptable loss for the firm and that dictates sizing on the position-, strategy- and portfolio-level. And then one should have an expected range of outcomes for these strategies if the fundamental drivers that are being exploited continue to exist. One can manage risk. One can't demand a threshold return from the market.

The world of risk in commodities is bifurcated. There are normal times, and there are "eventful" times. While Value-at-Risk (VaR) is a useful risk measure, it is only one part of a complete menu of risk metrics. VaR generally has meaning only during normal times and even then its usefulness has to be qualified since commodity returns aren't normally distributed. Commodity returns tend to have fat tails and are sometimes serially correlated.

Commodity futures investors generally desire a long options-like payoff profile. In other words, they like trades that are expected to have positive outcomes *and* that allow them to participate in extreme price spikes during supply disruptions. As a result, there tend to be two sets of strategies. The first is outright longs, either directly or as intra-market spreads. And the second is long processing margin trades. That is, one tends to be long the finished product and short the input. An example of a processing margin trade is a long gasoline crack spread. In this trade, one is long gasoline and short crude oil against it. The common theme to these trades is that an investor is taking on the other side of producer hedging pressure. For these trades, timing is key. One implements them at the peak of hedging pressure in anticipation of seasonal inventory draws or expected scarcity.

Example from the Spring of 2003

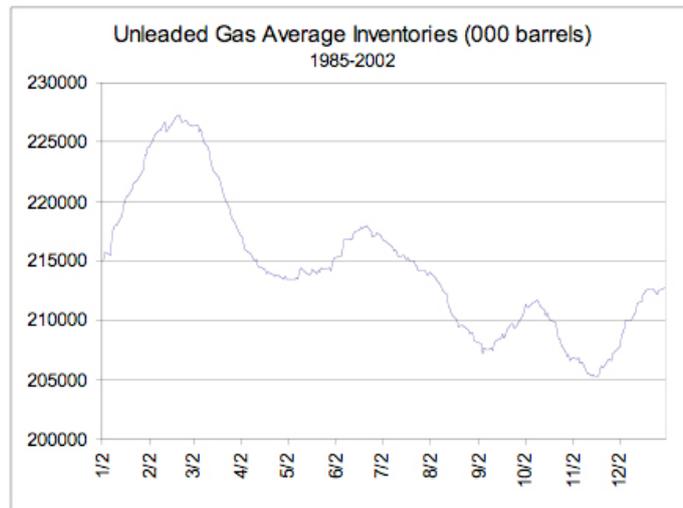
The following example from the spring of 2003 will highlight this class of trades.

Historically, there has been a strong incentive for refiners to produce enough gasoline in the spring prior to the US summer driving season. A well-known and popular trade has been to go long unleaded gasoline during this time.

Fundamental Rationale

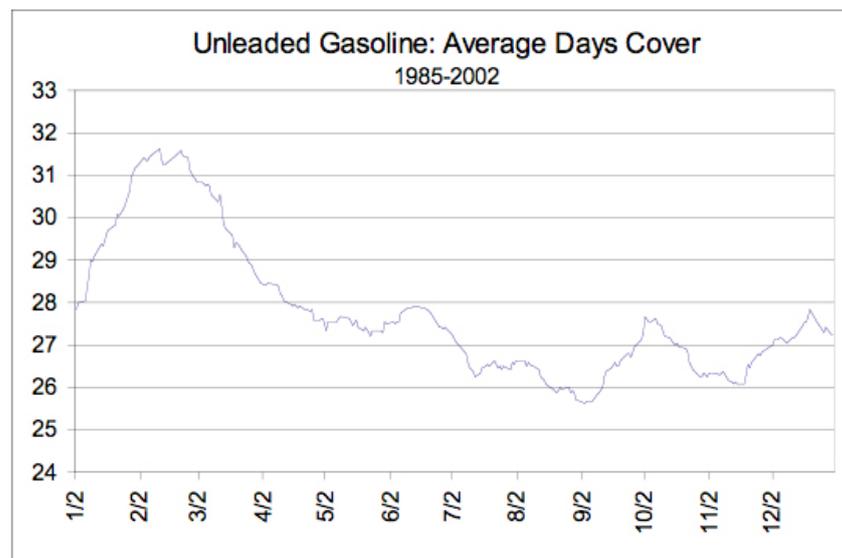
Exhibits 1 and 2 show US unleaded gasoline inventories both on an absolute basis and in terms of days-cover (which equal gasoline inventories divided by implied demand). The dataset covers 1985 through 2002.

Exhibit 1



Source: American Petroleum Institute, Bloomberg.

Exhibit 2



Source: American Petroleum Institute, Bloomberg

Both graphs communicate the same information. On average, inventories and days-cover both peak at the start of March, temporarily plateau in May and June, and then hit their lows in the fall following a smaller inventory build from late May through the end of June.

Cootner (1967) discusses how "profitable [futures] strategies ... [tend to be] keyed off ... peaks and troughs in visible ... supplies" in the grain markets. If this idea were to hold in the unleaded gasoline market, one would expect a long position initiated at the start of March and exited in May to be generally profitable. As shown in exhibits 1 and 2, May is a localized low point in the inventory cycle. The following table in exhibit 3 summarizes this precise trade.

Exhibit 3

Trade: Buy June Unleaded Gasoline contract. Enter approximately March 1st; Exit May 9th. performance in USD.

	Profit	Worst Mark
1985	2877	462
1986	5964	-1596
1987	1928	672
1988	2654	-328
1989	5011	-4
1990	609	-1865
1991	4767	790
1992	1982	-130
1993	462	-819
1994	1781	-991
1995	2801	-1050
1996	4019	-361
1997	798	-437
1998	-55	-2276
1999	5536	218
2000	3961	-4691
2001	8102	-294
2002	4187	1033
Average Profit	3188	
Z-stat	6.2	
Worst Mark	-4961	
2* Recent Volatility	9117 (over time horizon of trade)	

Source: Premia Capital Management, LLC

Trading Strategy

Cootner's strategy appears to be a successful one for the gasoline market. Over the 1985 through 2002 period, this strategy on average made \$3,188 per unleaded futures contract. However, the path to profitability was not without volatility. The maximum realized worst mark for this trade was negative \$4,691 per contract in 2000. ("Worst mark" is the worst drawdown over the time horizon of the trade.) And in the two months preceding the implementation of this trade, the realized Value-at-Risk actually exceeded the worst mark of the trade. In this case, a two-standard deviation event was \$9,117 per contract.

Trade Sizing

As an individual trade, this trade would have been sized off of its recent volatility. However, it's worth noting that, in general, recent volatility is rarely a useful measure in isolation. For some commodity trades, a historical analysis of the worst mark is the binding constraint. This can also hold at the strategy and portfolio level.

Strategy Bucketing

In 2003, the outright gasoline trade was only one of several bullish energy trades that were included in a spring energy strategy. Each of this strategy's positions was highly correlated to the fortunes of gasoline and so would have to share risk capital. Only positions which are unrelated to each other are awarded full risk capital.

The algorithm for determining the maximum size on individual positions is based on the more conservative of historical worst mark or recent volatility. The entire strategy bucket is then put through a return-to-risk optimization to determine the actual sizing of the individual positions in the strategy bucket.

Historical Worst Mark and Conditional Drawdown-at-Risk

The risk metric that we use is historical worst mark for the strategy. This is conceptually similar to Hooker's (2007) return-to-risk optimization, in which he replaces the standard tracking-error metric with a conditional drawdown-at-risk measure (CDaR). Hooker states that his CDaR optimization improved "portfolio performance on nearly all measures relative to mean-variance" in his historical simulations.

Out-of-Sample Performance

How did this gasoline trade perform out-of-sample?

In 2003, the trade actually exceeded its then historical worst mark, which entailed stepping out of the trade. The advantage to this rule is that it prevented losses from doubling, which would have occurred if one had held the trade through its trade horizon.

Exhibit 4 shows the out-of-sample performance of this trade. Note that the strong influence of gasoline's typical inventory cycle reasserted itself from 2004 through 2007. The average profit of the trade from 2003 to 2007, which includes 2003's losses, was more than double the average profit from 1985 through 2002.

Exhibit 4

Out-of-Sample Performance of Spring Gasoline Trade (Per Contract in USD)

	Profit/Loss (P/L) through Trade Horizon	Worst-Mark	Stop-Out	P/L
2003	-8400	-11176	-5288	-5288
2004	9622	-2675	NA	9622
2005	1147	-25	NA	1147
2006	14120	-802	NA	14120
2007	13663	-2495	NA	13663
Average P/L from 2003 through 2007:				6653

Source: Premia Capital Management, LLC

Example from the Summer of 2004

We will now provide an example from the summer of 2004 to illustrate the monitoring of portfolio event risks.

Event Risks

There are two key risks to a program that is long commodities through outright futures positions, calendar spreads, and/or through processing-margin spreads. The first is obvious. The investor is assuming directional risk in individual markets as well as on the strategy level. The second risk is less obvious. This type of investment program is very sensitive to a severe shock to business confidence. Examples include the 1990 Gulf war, the Long Term Capital Management crisis, and the aftermath of 9/11/01. In each of these scenarios, a standard Value-at-Risk analysis would underestimate risk. It's also the case that during "eventful" times, the portfolio can behave in non-intuitive ways.

Exhibit 5 shows seven strategies used during the summer of 2004.

Exhibit 5

Example of a Strategy-Level Risk Report

Strategy	Incremental Contribution to Portfolio Value-at-Risk*	Incremental Contribution to Worst-Case Portfolio Event Risk*
Gasoline Front-to-Back Spread	1.62%	0.64%
Deferred Outright Gasoline	2.93%	-0.72%
Deferred Outright Natural Gas	0.52%	0.16%
Deferred Eurodollar Futures	0.77%	-2.86%
Hog Spread	1.18%	-0.29%
Deferred Gasoline Spread	1.33%	0.29%
Cattle Spread	0.25%	-0.32%

* A positive contribution means that the strategy adds to risk while a negative contribution means the strategy reduces risk.

Source: Till and Egleeye (2006)

The first column in exhibit 5 shows the effect on the portfolio's Value-at-Risk when adding the strategy to the portfolio during "normal" times. The second column shows the change in "eventful" risk when one adds the named strategy to the portfolio.

Worst-Case Scenarios

This portfolio was especially sensitive to the Gulf war (1990), and the "eventful" risk numbers are from running the portfolio through that period. During normal times one would expect a gasoline front-to-back calendar spread to be less risky than an outright position in gasoline. And indeed this was the case, as seen in exhibit 5. However, positions can behave non-intuitively during certain events. During the Gulf War an outright position in gasoline reduced the event risk of the portfolio while a gasoline front-to-back spread actually increased event risk. Why? The Gulf war saw the entire price structure of gasoline go dramatically higher, but traditional market participants weren't always able to keep "normal" intra-market relationships in line during this time.

An examination of the portfolio's worst-case scenarios then assists in the design of macro hedges for the portfolio's risks.

Macro-Level Hedging

As discussed above, after putting together a portfolio's strategy buckets, one should combine them into a portfolio and stress test the portfolio through eventful times. One should also examine the portfolio's historical worst mark during normal times as well as its recent volatility. If any of these measures exceed a portfolio's risk threshold, one can do one of two things. Reduce all of the positions to get the portfolio in line with its risk limits or attempt to curtail risk through macro-level hedges and keep the portfolio "as is."

Natural Hedges

The portfolio in exhibit 5 contained a macro-level hedge in the form of a deferred eurodollar futures position. In many ways, this represents an ideal trade. It was a positive expected value trade during normal times, *and* it reduced the portfolio's worst-case loss under our eventful scenarios.

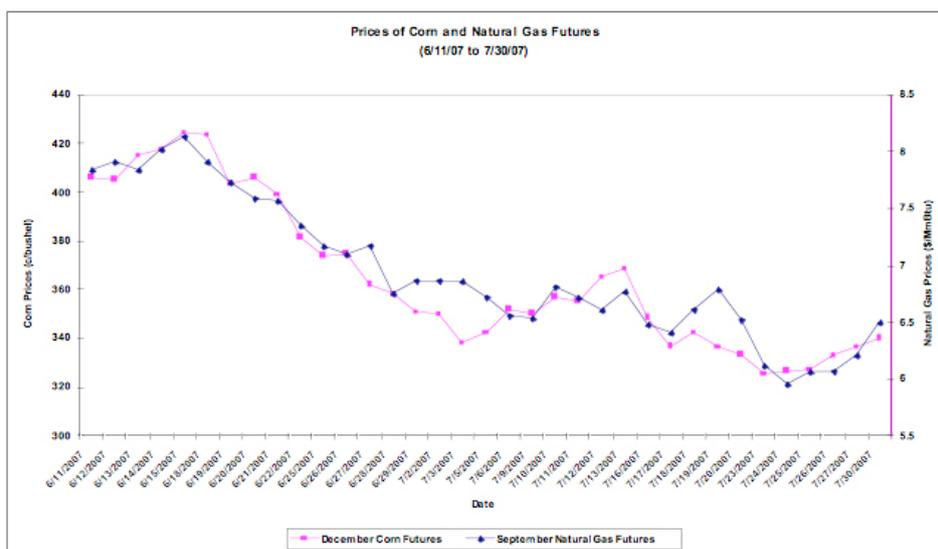
Strategy Example from 2007

We noted previously that only positions that are unrelated to each other are awarded full risk capital.

One example of trades that need to be classified in the same strategy bucket is directional position-taking in natural gas and corn during the summer. Both of these commodity markets are extremely sensitive to weather outcomes in the US Midwest, particularly in July. Exhibit 6 shows how the fortunes of natural gas and corn futures prices waxed and waned at similar times from June 11th through July 30th, 2007.

What this means for a commodity portfolio manager is that directional trades in these two markets need to share risk capital since both trades can be highly correlated.

Exhibit 6



Source: Premia Capital Management, LLC

Conclusion

Risk management may be the most important element of a trading program. One can attempt to manage risk on three levels: (1) at the individual trade level, (2) per strategy bucket, and (3) on a portfolio-wide basis. The type of process relies heavily on a menu of risk metrics, which attempt to manage event risk through the *prodigious* use of historical back-testing.

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- Till, H., and J. Eagleeye, (2006), "Commodities – Active Strategies for Enhanced Return", In Robert Greer, ed., *The Handbook of Inflation Hedging Investments*, (New York: McGraw-Hill). Also in *Journal of Wealth Management*, 2005, Fall, pp. 42-61.