Risk Management & Portfolio Construction in a Commodity Futures Programme

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This article focuses on risk management within the context of a total-return futures programme centred on commodities. The following issues will be addressed:

- **The evaluation of normal versus eventful risk.**
- **The sizing of trades and strategy buckets.**
- **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.

AT OUR COMPANY, the primary discussion we have before initiating a proprietary trade revolves around the economic service we are providing the market and the risk assumed by providing that service. *Risk management is perhaps the most important element of our commodity programme*. Traditional asset classes rarely experience the type of volatility encountered in commodity markets. For example, the implied and realised volatility of 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 only require US$7 for each US$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. We first decide on the largest acceptable loss for the firm and that dictates sizing on the position, strategy and portfolio level. We then have an expected range of outcomes for these strategies if the fundamental drivers we are exploiting continue to exist. Risk can be managed, but a threshold return from the market cannot be demanded.

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The world of risk in commodities is bifurcated – there are 'normal' and there are 'eventful' times. While Value-at-Risk (VaR) is one of the risk measures we use, it is only one part of a complete menu of risk-metrics. VaR generally only has meaning during normal times and even then its usefulness has to be qualified since commodity returns are not 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* which 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 intramarket spreads. 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. They are implemented at the peak of hedging pressure in anticipation of seasonal inventory draws or expected scarcity.

Example From the Spring of 2003

The following example 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

Figures 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.

Both graphs communicate the same information. 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. This follows a smaller inventory build from late May through to 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, the expectation would be a long position initiated at the start of March and exited in May would generally be profitable. As Figures 1 and 2 show, May is a localised low point in the inventory cycle.

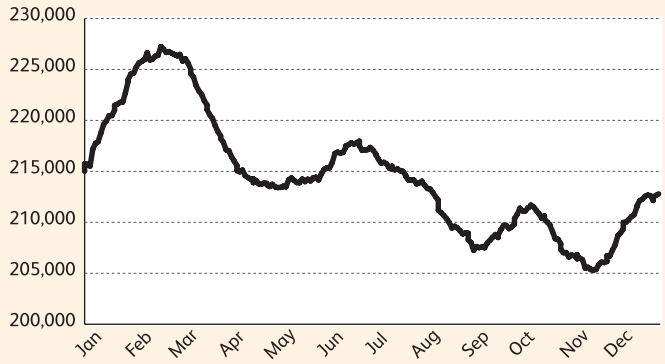
TABLE 1: BUY JUNE UNLEADED GAS

Enter approximately March 1st. Exit May 9th. (Performance in USD)

	Profit	Worst Mark
1985	2,877	462
1986	5,964	-1,596
1987	1,928	672
1988	2,654	-328
1989	5,011	-4
1990	609	-1,865
1991	4,767	790
1992	1,982	-130
1993	462	-819
1994	1,781	-991
1995	2,801	-1,050
1996	4,019	-361
1997	798	-437
1998	-55	-2,276
1999	5,536	218
2000	3,961	-4,691
2001	8,102	-294
2002	4,187	1,033
Average Profit	3,188	
Z-stat	6.2	
Worst Mark	-4,691	
2 * Recent Volatility	9,117	(over time horizon of trade)

Source: Premia Capital Management LLC

Figure 1: Unleaded Gas Av. Inventories (1985 – 2002, '000 bbl)



Sources: American Petroleum Institute, Bloomberg

Figure 2: Unleaded Gas: Average Days Cover (1985 – 2002)

Sources: American Petroleum Institute, Bloomberg

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 US$3,188 per unleaded futures contract. However, the path to profitability was not without volatility. The maximum realised worst mark for this trade was negative US$4,691 per contract (2000). ('Worst mark' is the worst drawdown one had historically experienced in holding this position over the time horizon of the trade.) In the two months preceding the implementation of this trade, the realised VaR actually exceeded the worst mark of the trade. In this case, a two-standard deviation event was US$9,117 per contract.

Trade Sizing

As an individual trade, this would have been sized off of its recent volatility. However, it is 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 & 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 in his historical simulations, "improved portfolio performance on nearly all measures relative to mean-variance."

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 stopping out of the trade. The advantage to this rule is that it prevented losses from doubling, which would have occurred if it had been held through its trade horizon.

Table 2 shows the out-of-sample performance of this trade. Note that the strong influence of gasoline's typical inventory cycle re-asserted 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 to 2002 period.

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 programme 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 2001. In each of these scenarios, a standard VaR analysis would underestimate risk. It is also the case that during 'eventful' times, the portfolio can behave in non-intuitive ways.

The first column in Table 3 shows the effect on the portfolio's VaR when adding the strategy to the portfolio during 'normal' times. The second column shows the change in 'eventful' risk when the named strategy is added to the portfolio.

Worst-Case Scenarios

This portfolio was especially sensitive to a Gulf War (1990) event, 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. Indeed, this was the case, as Table 3 shows.

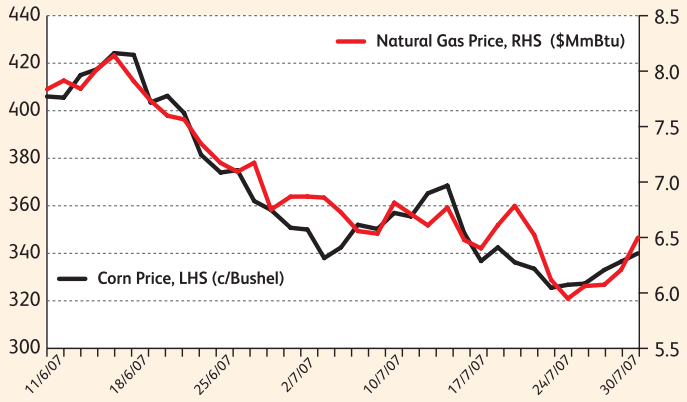
Table 2: Performance of Spring Gas Trade

(Per Contract in USD)

	Profit/Loss (P/L)			
	Through Trade Horizon	*Worst-Mark*	*Stop-Out*	*P/L*
2003	-8,400	-11,176	-5,288	-5,288
2004	9,622	-2,675	NA	9,622
2005	1,147	-25	NA	1,147
2006	14,120	-802	NA	14,120
2007	13,663	-2,495	NA	13,663
			Average P/L from 2003 through 2007:	**6,653**

Source: Premia Capital Management LLC

Figure 3: Prices of Corn & Natural Gas Futures



Source: Premia Capital Management LLC

However, positions can behave non-intuitively during 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 were not 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 assembling all of our strategy buckets, we combine them into a portfolio and stress test through eventful times. We also examine the portfolio's historical worst mark during normal times as well as examine the recent volatility of the portfolio. If any of these measures exceed our portfolio's risk threshold, we can do one of two things. Reduce all of the positions to get the portfolio in line with our risk limits or attempt to curtail risk through macro-level hedges and keep the portfolio 'as is'.

Table 3: Example of a Strategy-Level Risk Report

(Per Contract in USD)

	Incremental Contribution to:	
Strategy	**Portfolio VaR***	**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.

Notes:

While under 'normal' times, the gasoline spread position is less risky than the outright, during particular 'eventful' times the spread adds to risk while the outright reduces risk.

While under 'normal' times, the Eurodollar futures position adds to risk, during particular 'eventful' times this interest-rate position reduces risk.

Source: Till and Eagleeye (2006)

Natural Hedges

The portfolio in Table 3 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. Figure 3 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 during the summer since both trades can be highly correlated.

Conclusion

Risk management may be the most important element of a trading program. In our case, we attempt to manage risk on three levels:

(1) At the individual trade level,
(2) Per strategy bucket, and
(3) On a portfolio-wide basis.

Our process also relies heavily on a menu of risk metrics with an attempt to manage eventful risk through the prodigious use of historical back-testing •

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This article is largely drawn from chapter 20 of the book, Intelligent Commodity Investing (London: Risk Books, 2007). More information on this book can be found at:
www.riskbooks.com/intelligentcommodity

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