Risk Management Lessons in Leveraged Commodity Futures Trading

Practical issues involved in applying a disciplined risk management methodology to futures trading.

This article will show how to apply methodologies derived from both conventional asset management and hedge fund management to futures trading. It will also discuss some of the risk management issues, which are unique to leveraged futures trading. By **HILARY TILL**.

The Most Important Element of an Investment Process

THE KEY TO a successful investment programme is not in discovering proprietary investment strategies – a diligent literature search will turn up a great number of strategies. Instead, the most important element of an investment process is how one implements the programme's portfolio construction and risk management, so that one can have both smooth performance and stay in business during dramatic market moves.

Risk Management Policies are a Product Design Issue

In derivatives trading, one has a lot of flexibility in designing an investment programme. Futures trading requires a relatively small amount of margin. Trade sizing is mainly a matter of how much risk one wants to assume. An investor is not very constrained by the amount of initial capital committed to trading.

With the use of options, one can also be very particular about the risks that the investor wishes to hedge away by paying option premia.

We believe that the leverage level chosen for a programme and which risks are hedged are product design issues. One needs to determine *How will the programme be marketed, and what will the client's expectations be?*

A number of top Commodity Trading Advisors (CTAs) have had losses in excess of 40%, which have been acceptable to their clients since these investment programmes sometimes produce 100%+ annual returns. Investors know upfront the sort of swings in profits and losses to expect from such managers.

If an alternative investment programme were advertised as an equity diversifier, then clients would expect that the programme should not do too poorly in the face of a large equity decline.

The parameters of a programme's risk management policy should directly flow from the return, risk, and correlation expectations of the programme's client base. When attempting to adhere to these top-level parameters, the actual implementation of a programme's risk management policy will rely heavily on the particular assumptions about the statistical properties of futures prices.

> Risk management may be the most important element of an investment process <

Standard Risk Management Methodology from Conventional Asset Managers is a Useful Starting Point

The way that risk management is applied at conventional asset managers is typically as follows:

- Translate the client's guidelines into return and risk targets with respect to an index or benchmark.
- Determine the active bets away from a programme's benchmark.
- Make assumptions about the expected returns, volatility, and correlation of the active bets.
- Construct the client's portfolio so that the client's return and risk targets will be achieved if one's statistical assumptions are correct.
- Continually monitor the portfolio's actual return and risk performance for adherence to the established targets.

Risk management is designed into investment process. The conventional asset manager approach to risk management is a useful first step in designing a risk management programme for leveraged futures trading.

One still needs to add several layers of risk management to this approach because of the unique statistical properties of commodity futures contracts and because of the different way futures products are marketed.

A futures product typically does not have a benchmark, so the conventional asset manager approach of translating a client's guidelines into risk and return targets with respect to an index does not directly apply. Instead, one needs to determine what the acceptable total-return-to-total-risk trade-off is for a client. Given the ability to leverage, a number of CTAs offer 1-times, 2-times, and 3-times versions of the same programme. In other words, a client can directly choose the leverage level for their investment based on their ability to tolerate losses of a given magnitude.

The second step in a conventional asset manager approach to risk man-

agement consists of making assumptions about expected returns, risks, and correlations of active bets. It is at this point that the unique behaviour of commodity prices creates extra steps in a risk management programme.

Risk Management Rules Flow from an Understanding of Price Behaviour

Research from the 1970s showed that diversified portfolios of equities have returns that appear to be symmetrically distributed. It is a different matter for commodity prices.

Deaton and Laroque [1992] note the following about the empirical behaviour of the prices of a number of commodities:

- "Commodity prices are *extremely* volatile."
- There exist "rare but violent explosions in prices."
- In normal times, there is a "high degree of price autocorrelation."
- "In spite of volatility, prices tend to revert to their mean or to a ... trend," level.
- "There is substantial positive skewness" in the price distributions; and,
- There is "substantial kurtosis with tails much thicker than those of the normal distribution."

Commodity prices tend to exhibit positive skewness for the following reason. During times of ample supplies, there are two variables that can adjust to equilibrate supply and demand: more inventories can be held *and* the price can decrease. But, if there are inadequate inventories, *only* the price can respond to equilibrate supply and demand, given that in the short run, new supplies of physical commodities cannot be instantly mined, grown, and/or drilled.

Value at Risk

If a portfolio of instruments is normally distributed, one can come up with the 95% confidence interval for the portfolio's change in monthly value by multiplying the portfolio's recent monthly volatility by two (or 1.96, to be exact.) The portfolio's volatility is calculated from the recent volatilities and correlations of the portfolio's instruments. This is the standard Value-at-Risk approach. Now, this approach alone is obviously inadequate for a commodity portfolio, which consists of instruments that have a tendency towards extreme positive skewness.

While this measure is useful, it has to be used jointly with other measures and actions. The measure is useful since one wants to ensure that under normal conditions, a commodity position has not been sized too large that one cannot sustain the random fluctuations in profits and losses that would be expected to occur, even without a dramatic event occurring.

Sizing a trade based on its volatility is especially important the longer the frequency of predictability is. For example, if a trade's predictability is at quarterly intervals, the trade has to be sized to withstand the daily fluctuations in profits and losses.

Scenario Testing

The following recommendation can only be implemented if a programme's investment process is systematic and based on historical data.

> We would recommend examining the worst performance ... over the entire time horizon <

Using long-term data, one can directly examine the worst performance of a commodity trade under similar circumstances in the past. In practice, we have found that such a measure will sometimes be larger than a Value-at-Risk measure based on recent volatility.

We would recommend examining the worst performance of a futures trade over the entire time horizon of the trade rather than looking at what its worst performance was over a period of say, three days. We believe that markets are 'learning systems'. During a price shock, if a similar event occurred in the past, market participants know what the magnitude of the price move was during the past event. So an entire, dramatic price move may occur in a shortened time-frame compared to the past.

In practice, if a market only has limited historical data, it would be prudent to scale down the size of a position in such a market since one may not be able to get a complete idea of the range of possible outcomes.

If one is relying on historical data to find pockets of predictability in the futures markets, then examining worst-case outcomes can also serve another purpose. If the loss on a particular commodity futures trade exceeds the historical worst case, this can be an indication of a new regime that is not reflected in the data. This would trigger an exit from a systematic trade since one no longer has a handle on the worst-case scenario.

Deep Out-of-the-Money Options

In a systematic investment programme based on historical data, one can make determinations about the expected return of an investment. One result is that an investor can decide to give up a small fraction of this expected return in order to hedge against catastrophic risk. An investor can do so with deep out-of-the-money options.

This choice is especially advisable for commodity futures positions that require physical delivery at maturity. This means that contracts can be periodically squeezed to quite unpredictably high levels.

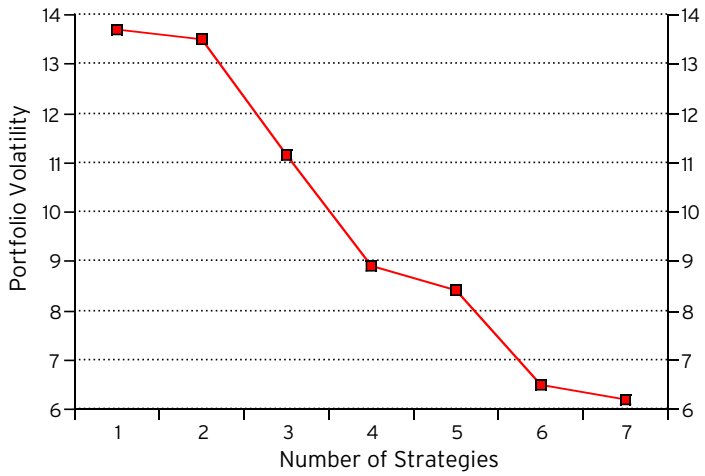
Diversification & Concentration Risk

A commodity investment manager can potentially set up dampened risk portfolios of commodity investments, which are very nearly uncorrelated with each other. (see Figure 1.).

Now for all types of leveraged investing, a key risk management concern is inadvertent concentration risk.

In our own work, we have found that seemingly unrelated commodity markets can become temporarily highly correlated. This becomes problematic if a commodity manager is designing their portfolio so that only a certain amount of risk is allocated per strategy. The portfolio manager may be inadvertently doubling up on risk if two strategies are unexpectedly correlated.

Fig 1. Portfolio Volatility vs Number of Strategies



Source: Till, Hilary, *"Passive Strategies in the Commodity Futures Markets,"* Derivatives Quarterly, Fall 2000, p. 54.

Understanding the Fundamental Drivers of a Strategy

The antidote for this problem is two-fold. One is to understand what the key factors are which drive a strategy's performance, and the other is to use short-term recent data in calculating correlations. If two trades have common drivers, then it can be assumed that their respective performances will be similar. Recent data can frequently capture the time-varying nature of correlations that long-term data average out.

Extraordinary Stress Testing

As discussed above, risk management policies flow from product design decisions. Futures products are typically marketed as equity investment diversifiers. Therefore, one job of risk management is to attempt to ensure that a futures investment will not be correlated to the equity market during periods of dramatic equity losses.

This extra risk management step is unique to alternative investments, again, because of the way they are marketed. For example, funds of hedge funds are also marketed as equity diversifiers, so this is also a particular area of concern for such funds. Since fund-of-funds typically include a lot of arbitrage strategies, which in turn rely on the ability to leverage, fund-of-funds are at risk to liquidity shocks. And the equity markets typically also do poorly during liquidity shocks.

One solution advanced by a prominent fund-of-fund manager is to include an interest rate overlay in their fund. The interest-rate overlay consists of going long Eurodollar futures, which do well when short-term interest rates are cut. The Federal Reserve Board's response to liquidity shocks during the last 15 years has been to cut short-term interest rates, so a Eurodollar overlay could plausibly offset losses in portfolios consisting of arbitrage strategies.

This type of macro hedging is very applicable to commodity futures investments as well. A number of commodity futures strategies have a *long commodity bias* since they rely on taking on inventory risk that commercial participants wish to lay off. One consequence is that these strategies are at risk to sharp shocks to business confidence. And during sharp shocks to business confidence as occurred in the aftermath of September 11th 2001, the stock market performs quite poorly.

As noted before, the Greenspan Fed has responded to financial shocks by cutting interest rates, which has resulted in the stock market stabilising. As long as this type of policy continues, one way to hedge a portfolio that has exposure to shocks to business confidence is to include a fixed income hedge. The hedge could take the form of either a Eurodollar futures contract overlay or purchases of out-of-the-money fixed-income calls. This recommendation is similar to that of the fund-of-funds manager noted above, whose portfolios were at risk to liquidity shocks.

Obviously one would prefer to layer on natural hedges, which themselves have positive expected value. We have found that this is sometimes possible in a diversified futures programme. For example, in the fall there tends to be a number of statistically significant commodity trades that have a long bias. Also, at the same time there are a number of statistically significant long fixed income trades. By carefully combining these trades, the fixed income trades operate as a natural hedge to the event risk taken on with the long commodity trades.

The hedge fund world also provides other risk management solutions that are applicable to futures investments. One concern for a fund-of-funds is that its group of funds is inadvertently exposed to some event risk like an emerging markets shock. This issue is compounded by the fact that a hedge fund investor is not allowed to see what a hedge fund is investing in because this is considered proprietary information by a hedge fund.

> … how one designs and carries out a risk management policy is key to an investment programme's viability <

One risk management software provider, *Measurisk*, solves this problem by confidentially collecting hedge fund portfolios and directly determining their sensitivity to past financial shocks. For example, if one held a particular fund-of-funds portfolio during October 1987, one could see how that portfolio would have performed during the stock market crash. This scenario test gives an indication of sensitivity to such a crash.

For a commodity futures portfolio, we believe that it is prudent to examine how the portfolio would have performed during various well-defined stock market declines, given that such investments are marketed as equity portfolio diversifiers. Also, various

crises have shown that the only thing that goes up during such times is correlation!

If a portfolio shows sensitivity to certain extreme events when the stock market has declined, this does not necessarily mean that the portfolio should be sized or constructed differently. It may mean that a macro portfolio hedge would be in order such as purchasing out-of-the-money Eurodollar call options, as noted above.

Useful Risk Management Reports in Futures Trading

On a per-strategy basis, it is useful to examine each strategy:

- Value-at-Risk based on recent volatilities and correlations.
- Worst-case loss during normal times.
- Worst-case loss during well-defined eventful periods.
- Incremental contribution to portfolio Value-at-Risk.
- Incremental contribution to 'Worst-Case Portfolio Event Risk'.

The latter two measures give an indication if the strategy is a risk reducer or risk enhancer.

On a portfolio-wide basis, it is useful to examine the portfolio's:

- Value-at-Risk based on recent volatilities and correlations.
- Worst-case loss during normal times.
- Worst-case loss during well-defined eventful periods.

Each measure should be compared to some limit, which has been determined based on the design of the futures product. So for example, if clients expect the programme to lose no more than say 7% from peak-to-trough, then the three portfolio measures should be constrained to not exceed 7%. If the product should not perform too poorly during financial shocks, then the worst-case loss during well-defined eventful periods should be constrained to a relatively small number. If that worst-case loss exceeds the limit, then one can devise macro portfolio hedges accordingly.

Now obviously the danger with these recommended approaches is that one is relying on historical data for guidance since completely unprecedented events do happen. That is why we recommend exiting any futures trades in which the losses exceed those known in history since one is then in uncharted territory.

Strategy	Value-At-Risk	Worst-Case Loss During Normal Times	Worst-Case Loss During Eventful Period
Deferred Reverse Soybean Crush Spread	2.78%	-1.09%	-1.42%
Long Deferred Natural Gas Outright	0.66%	-0.18%	-0.39%
Short Deferred Wheat Spread	0.56%	-0.80%	-0.19%
Long Deferred Gasoline Outright	2.16%	-0.94%	-0.95%
Long Deferred Gasoline vs. Heating Oil Spread	2.15%	-1.04%	-2.22%
Long Deferred Hog Spread	0.90%	-1.21%	-0.65%
Portfolio	3.01%	-2.05%	-2.90%

Strategy	Incremental Contribution to Portfolio Value-At-Risk*	Incremental Contribution to Worst-Case Portfolio Event Risk*
Deferred Reverse Soybean Crush Spread	0.08%	-0.24%
Long Deferred Natural Gas Outright	0.17%	0.19%
Short Deferred Wheat Spread	0.04%	0.02%
Long Deferred Gasoline Outright	0.33%	0.81%
Long Deferred Gasoline vs. Heating Oil Spread	0.93%	2.04%
Long Deferred Hog Spread	0.07%	-0.19%

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

Source: Premia Capital Management, LLC

The chart above gives examples of a futures portfolio with the recommended measures displayed. Note for example, the properties of the soybean crush spread. It is a portfolio event-risk reducer, but it also adds to the volatility of the portfolio.

An incremental-contribution-to-risk measure based solely on recent volatilities and correlations does not give complete enough information about whether a trade is a risk reducer or risk enhancer.

Conclusion

Our view is that there are a number of commodity derivatives strategies, which earn returns due to assuming risk positions in a risk-adverse financial world. The returns are not necessarily due to inefficiencies in the marketplace.

There is a very important active component to an investment programme that earns a return due to bearing risk. It is the investment programme's risk management methodology and policy. An investment manager must decide how much to leverage the strategy and whether to give up any returns by hedging out some strategy's extreme risks. That investment manager must also continually monitor the risk exposures in his or her portfolio and make sure that those exposures adhere to pre-defined limits.

In designing a risk management framework, a leveraged futures trader can use as a starting point the framework provided by conventional asset managers and also by fund or hedge fund managers.

We conclude by noting that how one designs and carries out a risk management policy is key to an investment programme's viability, especially in leveraged commodity futures trading ■

Bibliography

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