



Trading Blow-Ups, Liquidity, Leverage and Risk Management

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The Risk Desk. January 2007.

Trading firm blow-ups can often be attributed to one of three basic causes: Overlying concentrated exposure, excessive leverage or writing instruments with options-like payoffs. Among well-known examples are MG's front-to-back oil market positions, the attempt by Sumitomo's "Mr. Five Percent" to corner the copper market and recent losses faced by Amaranth and MotherRock in natural gas calendar spreads. Trading firms that implement a comprehensive risk process integrating liquidity and leverage risk could substantially reduce the likelihood of experiencing these kinds of problems.

Limited use of traditional risk measures such as Value At Risk (VaR)

Most energy and commodity trading firms use VaR to set limits as well as for reporting purposes. VaR provides an indication of the possible loss in a static world, in which it is possible to liquidate our positions at any point in time, and where our losses can be limited to a one-day market shock based on historical parameters. If we know our exposure (e.g. linear or non-linear) to a set of market risk factor changes, we can make a theoretical estimate of the amount of money we could lose based on adverse moves of those risk factors for a given confidence level.

VaR is a useful risk management tool, but it has limitations, particularly in a market crisis. The main reasons are:

- The length and magnitude of the individual and joint market shocks is likely to be larger and more pronounced than most risk models predict.
- Regardless of whether we have stop-loss limits or any other risk-based limits in place, we may not be able to exit our positions in a timely and orderly manner. In those cases, the limits may provide a false sense of security.
- We are interested in the cumulative losses we could experience over a particular period where we cannot – or choose not to - liquidate our holdings, not just on the losses on any given day.

Multi-period Risk Measures

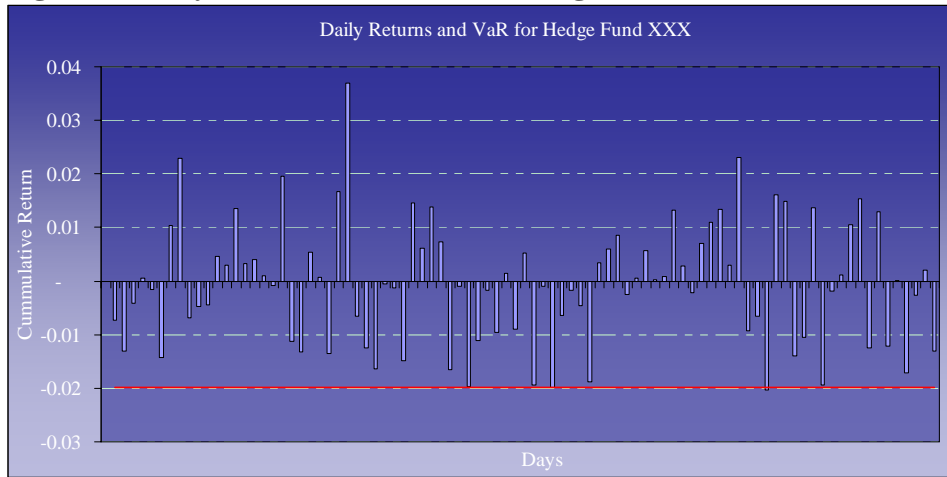
In order to realistically account for risk in a dynamic fashion, including crisis periods, we need a multi-period measure of risk. Some of the measures commonly used by hedge fund analysts are Maximum Drawdown (MDD), which provides a "backward-looking" worst-case loss estimate by measuring the largest "peak-to-valley" drop from a fund or investment during a particular time period.

If we have the ability to simulate multi-period returns, we can also estimate a **Maximum-Drawdown-at-Risk** or MDDaR, which indicates the magnitude of the largest loss during

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a particular time period. To compute MDDaR, we use the framework to compute Potential Future Exposure for counterparty risk, but analyze the potential losses rather than the potential gains. Under that framework, we calculate a multi-period VaR or Expected Tail Loss (ETL) (meaning VaR or ETL as a function of time) to determine a profile similar to those used for PFE by calculating the cumulative losses that could be experienced at various points in time with a given probability. We can also integrate possible liquidation strategies based on market liquidity as well as trading limits.

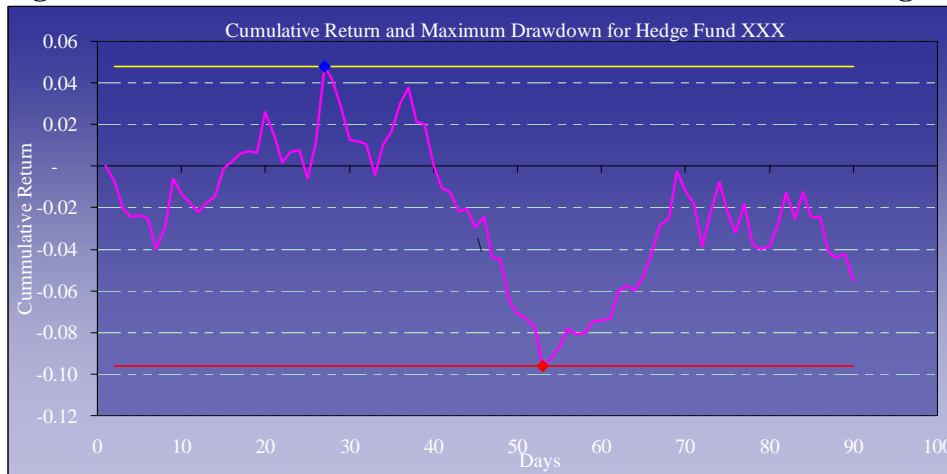
Figure 1: Daily Returns and VaR for Hedge Fund XXX



Source: Black Swan Risk Advisors, LLC.

In Figure 1, we can see how the daily VaR for hedge fund XXX at the 99 percent level is about 2 percent. But if we calculate a multi-period measure based on the cumulative returns (see Figure 2), we can see how our losses could be substantially larger. In this case, the Maximum Drawdown would be around 14 percent, seven times larger than the original VaR measure. This is a clear illustration of the limitations of VaR as a risk measure.

Figure 2: Cumulative Returns and Maximum Drawdown for Hedge Fund XXX



Source: Black Swan Risk Advisors, LLC.



Understanding the dynamics of multi-period risk measures

Despite the large number of articles and research pieces on VaR, academics and traders have attached relatively little importance to the study of multi-period risk measures.

Contrary to our basic intuition, the maximum drawdown is not highly dependent on the skewness and kurtosis of the portfolio returns. The main reason is that MDD is based on cumulative returns. Therefore, as we add them up, the kurtosis and skewness of the portfolio tend to be of lesser importance than for one-period measures such as VaR.

A trader or a hedge fund manager's drawdown is a function of the volatility of the portfolio, the realized or expected returns and the length of the time period (backwards for historical analysis and forward-looking for simulated drawdowns).

Understanding leverage in energy derivatives portfolios

Even though it's common to use the word leverage when referring to energy derivatives portfolios, the term does not adhere to a single definition. Leverage is most often defined in terms of profits or losses vs. the capital deployed for a particular investment.

The main trading strategy of Amaranth and MotherRock consisted of forward and option contracts betting that the spread between March and April delivery months would widen or tighten. Using the standard definition, Amaranth's leverage in the firm's energy portfolio was slightly above 5 to 1. That leverage ratio was not uncommon for financial market standards, but based on the size and volatility of the calendar spreads that the firm was trading, the firm was betting the house.

The risk managers may have operated under the assumption that risk of spread positions was considerably lower than outright positions, but given the size of the positions and the volatility of the spreads, those calendar spreads had risk characteristics similar to outright positions.

Amaranth relied on risk models to capture the risk of their energy derivatives positions, but it appears that common sense was missing from the picture. The fluctuation of energy derivatives in the months preceding the large losses -- and the size of the positions -- should have made many alarms go off.

In 2005, Amaranth's energy portfolio made over \$800 million in profits based on highly leveraged bets that benefited from the extreme natural gas market moves following Hurricanes Katrina and Rita. Brian Hunter, the fund's "start trader" received a bonus in the \$75-100 million range and also persuaded the CEO to move his trading operation to Calgary, several thousand miles away from Amaranth's risk group in Connecticut.

One of the oldest investment adages says: "*Bulls make money, bears make money, pigs get slaughtered.*" Just two months before the fund lost over \$6 billion in a little over a week, Amaranth's CEO told investors that the fund would maintain its large natural gas

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spread positions and said that "what Brian is really, really good at is taking controlled and measured risk."¹

Amaranth's original expertise was in convertible bonds and fixed income arbitrage. As is common in hedge fund strategies, the entrance of new players had reduced the expected returns from convertible bond arbitrage strategies. In 2005, low convertible prices and decreasing volatility levels for equities meant that Amaranth had to find another market that offered large potential returns without giving the appearance that the firm was taking too much risk. Energy markets have exhibited high volatility in recent years, allowing the firm to take large positions without leveraging themselves excessively (at least, according to traditional leverage measures).

Nicholas Maounis, Amaranth's CEO, implored Brain Hunter to "do something" to get the firm back in the black. It is unlikely that Maounis would have taken extremely large positions in markets where the firm had little experience if it had been enjoying profitable results in its core trading businesses².

A possible explanation of the risk modeling problems with natural gas spreads was that the risk management's group main expertise was in fixed income and equity markets, not energy. The Chief Risk Officer of Amaranth was Robert Jones, former managing director and CIO of Goldman Sachs Asset Management Global Quantitative Equity group. When Amaranth started aggressively increasing its exposure to energy markets, the firm did not seem to adequately upgrade its policies, systems and knowledge to reflect the nature of its new exposures. Energy market fluctuations are considerably different than those experienced in other financial markets. For example, the risk characteristics of a long/short equity spread position are inherently different than a calendar spread between future months. As Amaranth's "unrealized" profits grew in the months leading up to September, the risk of a sudden spread reversal was probably higher too. Amaranth probably knew that any attempt to lock-in profits by unwinding positions could also drive the spread to considerably lower levels given the size of its book.

Regardless of how we define leverage, what it is critical to understand is that leverage by itself is not an accurate estimator of the probability of a "blow-up." What we need to focus is on the analysis of the possibility that the fund will be forced to liquidate positions. If leverage is 5:1, a drop of 20 percent in the spread would prompt liquidation of some positions in other parts of the portfolio.

¹ See Davis (2006).

² For more information see:

<http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aRJS57CQQbeE>

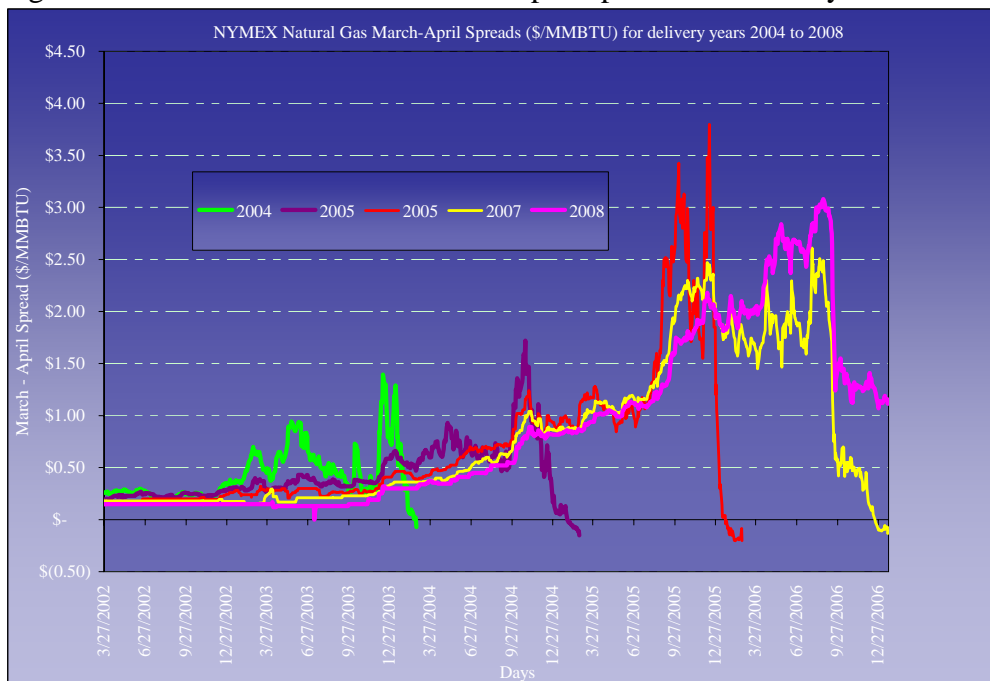
Other liquidity and leverage measures: Dynamic leverage and 'the need to liquidate'

Dynamic leverage is a concept based on traditional portfolio insurance, and was developed to identify the critical liquidation level of a fund (or a trader) after which there would be a need to liquidate to meet margin calls and redemptions. Dynamic leverage depends on the level of hedge fund volatility, time horizon and the difference between the fund's net asset value and its critical liquidation level.³

Another measure that risks managers could track is "the need to liquidate."⁴ The need to liquidate may be caused by:

- Large market moves prompting margin calls. The nature of the margin calls and collateral arrangements, as well as the volatility of the underlying investments, will determine when a fund may need to liquidate.
- Investor redemptions. Investors in traditional mutual funds have the equivalent of a put option with strike equal to the fund's Net Asset Value at the liquidation date (or the following business day). However, investors in hedge funds as well as energy trading firms do not know their NAV with any certainty. Hedge funds usually have redemption windows when investors can decide to pull out of the fund. Once the decision is made, a number of weeks or months may pass by before the funds are returned to investors.
- Counterparties reducing or eliminating existing credit lines.

Figure 3: NYMEX Natural Gas March-April Spreads for delivery from 2004 to 2008



Source: Black Swan Risk Advisors, LLC

³ For more information, see De Souza et al (2004).

⁴ For a more detailed explanation of the liquidity cycles and their impact in trading strategies, see Bookstaber (2000)



The need to liquidate as a result of market losses is a function of the effective leverage of the fund as well as the liquidity of the rest of the portfolio vs. the potential liquidity demands that the fund has to face. For example, if the fund has several months to liquidate positions because of the contracts it has with investors and the leverage is not high, they cannot be forced to liquidate positions in a suboptimal way.

If the fund has large illiquid positions and the managers are forced to close some positions, they may incur large costs to exit their positions. That's exactly what happened to Amaranth and MotherRock, where managers underestimated the "need to liquidate" illiquid positions as well as the consequences of their decision to unwind certain components of their portfolio.

In the case of Amaranth, the fact that the natural counterparties were physical market players who already had hedges in place made the liquidation of their positions, particularly those beyond 2007, particularly difficult and costly.

From a *redemption policy* point of view, it appears that most investors committed to keeping their money for a least a year, and the firm had the right to restrict the amount of redemptions in any quarter to 7.5 percent of total funds. However, the large market moves that took place in natural gas in early September 2006 prompted very large margin calls that the managers had to fund by liquidating other instruments in their portfolio. In addition, investors lost trust in the fund's management and demanded that the fund return the capital that was left after selling the energy portfolio at a significant discount.

Concluding thoughts

The most obvious lesson of the recent hedge fund debacles is that the backbone of the risk process should move from risk models to experienced risk managers who possess the authority and have the willingness to take quick action⁵. In addition, risk managers should not hide behind mathematical formulas to justify their inaction.

Multi-period risk measures should complement and possibly take priority over one-period measures such as VaR, which do not capture adequately the risk in the presence of leverage, illiquidity and/or markets that can experience large fluctuations for prolonged periods of time.

Incorporating multi-period measures into the risk management process has an additional benefit: it directly addresses the all-too-human reluctance to quickly close out losing positions. Traders often become emotionally invested in a trading position, and realizing a large loss is seen as a personal failure. Even in situations where adequate liquidity exists to close out a losing position, there is an inherent tendency to avoid "locking in a loss." Such situations are most likely to be found far from Wall Street, in organizations

⁵ Even though Amaranth has a CRO, Amaranth's head trader was probably the "informal" head of risk management. Several fund managers that invested in Amaranth felt that the firm withheld information that was crucial to understand the risk profile of the firm.



whose principal business is not trading and whose formal risk disclosure policies are often non-existent.

Reluctance to cut losses in the short run is also related to the asymmetric payoff function facing most traders. Locking in a large loss will almost certainly result in loss of esteem, loss of confidence by senior management and potentially the loss of employment. If you were in this situation, wouldn't you be tempted to let the bad position "ride" a while?

A clearly articulated funding and trading liquidity risk strategy, including leverage and concentration risk guidelines and a contingency plan, is critical for survival in extreme market conditions. Risk managers should attempt to model "the need to liquidate" and include a disciplined process to reduce leverage as markets significantly move against your positions.

One of the authors once had a conversation with a risk manager at a large utility concerning forward MTM losses in its power generation division. He asked this manager what he would do if he were absolutely certain that market conditions were going to get worse – would he hedge away the exposure and lock in a relatively small loss? The risk manager flashed a look that implied the author had suddenly gone insane and sneered, "Why would we ever do something like that? No one hedges to lock in a loss!"

On the contrary, as the old trader saying goes, "*The first loss is the best loss.*"

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