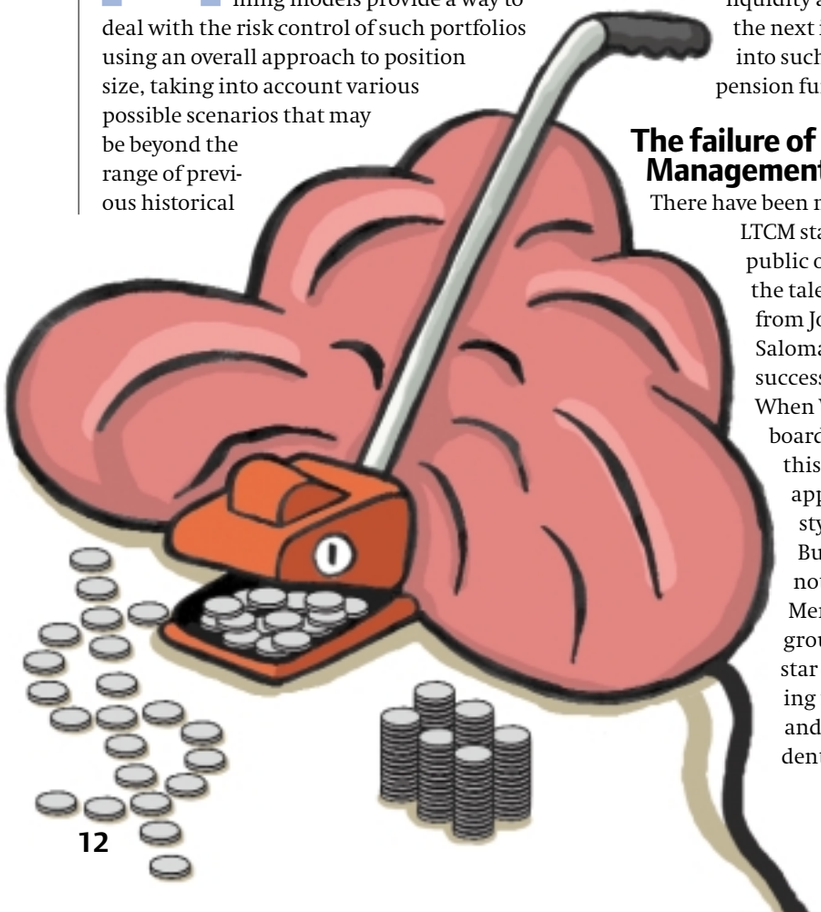
Bill Ziemba

Hedge Fund Risk, Disasters and Their Prevention

The funds that were meant to suck, metaphorically

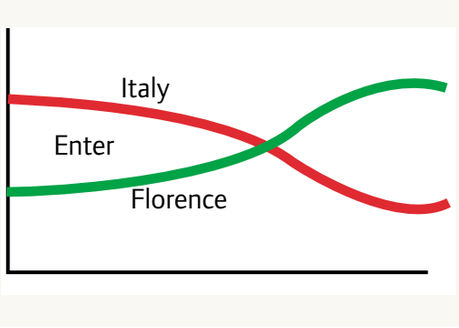
Hedge fund disasters usually occur because there is overbetting, the portfolio is not truly diversified and the trouble arises when a bad scenario occurs. Stochastic programming models provide a way to deal with the risk control of such portfolios using an overall approach to position size, taking into account various possible scenarios that may be beyond the range of previous historical data. Since correlations are scenario dependent, this approach is useful to model the overall position size. In short, the model will not allow the hedge fund to maintain positions so large and so under-diversified that a major disaster can occur. Also the model will force consideration of how the fund will attempt to deal with the bad scenario because once there is a derivative disaster, it is very difficult to resolve the problem. More cash is immediately needed and there are liquidity and other considerations. In the next issue I will go more deeply into such models in the context of pension fund management.



The failure of Long Term Capital Management

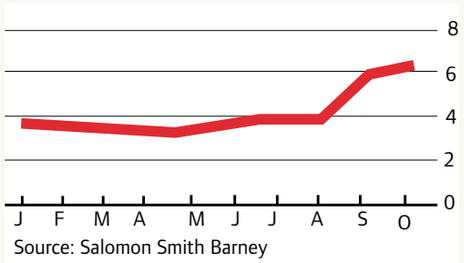
There have been many hedge fund failures but LTCM stands out as a particularly public one. The firm started with the talents of the core bond traders from John Merriwether's group at Saloman Brothers who were very successful for a number of years. When Warren Buffett came on board at Saloman the culture of this group clashed with Buffett's apparently more conservative style. Although in truth Buffett's record is Kelly like and not all that different from Merriwether's group. A new group was formed with an all-star cast of top academics including two future Nobel Laureates and many top professors and students, many linked to MIT. In addition top government officials were involved. The team was dubbed 'too smart to lose' and several billion was raised even though there was no real track record, fees were very high (25 per cent of profits) and entry investment ($100 million minimum) was also high. The idea, according to Myron Scholes, was to be a big vacuum cleaner sucking up nickels all over the world. There were many trades, but the essence of the bond risk arbitrage was to buy underpriced bonds in various locales and sell overpriced bonds in other locales and then wait for the prices to revert to their theoretical efficient market prices and then to unwind the position. These trades are similar to the Nikkei put warrant risk arbitrage (described in an earlier column) Thorp and I did except that the leverage they used was much greater. I like to call these bond trades *buy Italy and sell Florence*. As shown in the graph below, the interest rate implied by the bond prices is higher in Italy than in Florence. But the theory is that Florence, a smaller place, would have more risk. Hence, the trade should have an advantage and be unwound when the prices reverted to their true risk priced values.

LTCM analysts made many such trades, most much more complex than this, all across the world. They also had many other complex and innovative trades. Their belief that markets were efficient and, when temporarily out of whack, would snap back quickly and the continuous lognormal assumptions of option pricing hedging led them to take very large positions which according to their theory were close to riskless. The plan worked and net returns for the part of the year 1994 that the fund operated were 19.9 per cent. The years 1995 and 1996 had



similar superb results of 42.8 per cent and 40.8 per cent, respectively. Indeed for the principals whose money grew fee-less and with deferred taxes, the net returns were 63 per cent and 57 per cent with deferred taxes, respectively. There was so much demand for investment in the fund, which in 1997 was effectively closed to new investors that a gray market arose with a 10 per cent premium. By 1997 it became harder to find profitable trades and the gains fell to 17.1 per cent. This was a good record for most but not satisfactory to LTCM's principals; among other things the S&P500 returned 31 per cent without dividends. The action was to return $2.7 billion of the $6.7 billion investor money and to put in an additional $100 million of personal loans to the principals from banks. Banks and most others were quite keen to loan to or invest with this group and investors were not happy to leave the fund. Still $1 on February 24, 1994, at the start was $2.40 net at the end of 1998. The year 1998 was difficult for the fund and then turned into a disaster following the August 17 Russian ruble devaluation and bond default. Bonds denominated in rubles trading for say 60 fell rapidly to 3 whereas Russian bonds denominated in marks or dollars only fell a few per cent as they were not subject to default. So long 60 short 95 say became long 3 short 92 say.

Such losses occur from time to time in various markets and hedge funds which overbet can be very vulnerable to it. The problem for LTCM was that they had $1.25 trillion of positions in notational value (that's about 1 per cent of the world's derivatives) and $125 billion of borrowed money. Although the trades were all over the world and hence it seemed they were diversified, they in fact



Difference in yield of high-yield bonds and US Treasuries in percentage points

were not. What happened was a scenario dependent correlation situation like that modeled in the Innovest pension application that I will describe in my next column. There was an underlying variable that frequently rears its ugly head in disasters that being investor confidence. The second graph illustrates the problem: all the bond rates increased for non-high-quality debt. For example, emerging market debt was trading for 3.3 per cent above US T-bonds in October 1997, then 6 per cent in July 1998 and then an astounding 17 per cent in September 1998.

LTCM was unable to weather the storm of this enormous crisis of confidence and lost about 95 per cent of their capital, some $4.6 billion including most of the principals' and employees' considerable accumulated fees. The $100 million loan actually put some of them into bankruptcy, although others came out better financially. It did not help that they unwound liquid positions first rather than across all liquidity levels as the Nobels recommended, nor that many other copycat firms had similar positions, nor that LTCM had created enemies by being so good and so brash, nor that the lack of monitoring of margin by brokers eager for their business allowed the positions to grow to overbet levels, and finally that the $2.8 billion was gone and they could not draw on it when it was most needed. Smart people bounce back and learn from their mistakes as has this group in new hedge funds and other ventures. The lessons are:

- Do not overbet, it is too dangerous
- VaR type systems are inadequate to measure true risk but see Jorion's (2000) fine book on VaR and Dunbar's (2000) discussion of this
- Be aware of and consider extreme scenarios
- Allow for extra illiquidity and contract defaults
- Really diversify (to quote Soros, "we risked 10 per cent of our funds in Russia and lost it, $2 billion, but we are still up 21 per cent in 1998")
- Historical correlations work when you do not need them and fail when you need them in a crisis when they approach one. Real correlations are scenario dependent.

Good information on the demise of LTCM and the subsequent $3.5 billion bailout by major brokerage firms organized by the FED are in a Harvard Business School case by Andre Perold (1998), and articles by Philippe Jorion (2000a) and Franklin Edwards (1999). Eventually the positions converged and the bailout team was able to emerge with a profit on their investment.

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The currency devaluation of some two thirds was no surprise to me. In 1992 my family and I were the guests in St. Petersburg of Professor Zari Rachev, an expert in stable and heavy-tail distributions and editor of the first handbook in North Holland's Series on Finance (Rachev, 2003) of which I am the series editor. As we arrived I gave him a $100 bill and he gave me six inches of 25 Ruble notes. Our dinner out cost two inches for the four of us; and drinks were extra in hard currency. So I am in the Soros camp; make bets

in Russia if you have an edge but not risking too much of your wealth.

Where was the money lost? The scorecard according to Dunbar (2000) was a loss of $4.6 billion. Emerging market trades such as those similar to my buy Italy, sell Florence lost $430 million. Directional, macro trades lost $371 million. Equity pairs trading lost 306 million. Short long-term equity options, long short-term equity lost $1.314 billion. Fixed income arbitrage lost $1.628 billion.

The bad scenario of investor confidence that led to much higher interest rates for lower quality debt and much higher implied equity volatility had a serious effect on all the trades. The long-short equity options trades, largely in the CAC40 and Dax equity indices, were based on a historical volatility of about 15 per cent versus implieds of about 22 per cent. Unfortunately, in the bad scenario, the implieds reached 30 per cent and then 40 per cent. With smaller positions, the fund could have waited it out but with such huge levered positions, it could not. Equity implieds can reach 70 per cent or higher as Japan's Nikkei did in 1990/1991 and stay there for many months.

The lessons for hedge funds are much as with LTCM. Do not overbet, do diversify, watch out for extreme scenarios

The imported crash of October 27 and 28, 1997

A currency crisis developed in various Asian countries in mid 1997. It started in Thailand and moved all across the region. The problem was lack of foreign reserves that occurred because spending and expectations that led to borrowing were too high and Japan, the main driver of these economies, was facing a consumer slowdown so imports dropped. Also loans were denominated in what was considered a weak currency, the US dollar. So that effectively these countries were long yen and short dollars. A large increase in the US currency in yen terms exacerbated the crisis. The countries devalued their currencies, interest rates rose and stock prices fell. A well-known hedge fund failure in 1997 was Victor Niederhoffer's fund, which had an excellent previous record with only modest drawdowns. A large long bet on cheap Thai stocks that became cheaper and cheaper turned $120 million into $70 million. Buying on dips added to losses. Then the fund created a large position in out-of-the-money S&P futures index puts. A typical position was November 830's trading for about $4-6 at various times around September 1997.

The crisis devastated the small economies of Malaysia, Singapore, Indonesia, etc. Finally it spread to Hong Kong. There, the currency was pegged to the US dollar at around 7.8. The peg was useful for trade and was to be defended at all costs. The weapon used was higher interest rates which almost always lead to a stock market crash but with a lag. See the discussion in chapter 3 of my AIMR book (Ziemba, 2003) for the US and Japan and other countries. The US S&P500 was not in the danger zone by my models and I presume by others and the trade with Hong Kong and Asia was substantial but only a small part of the US trade.

The week of October 20-25 was a difficult one with the Hang Seng dropping. The S&P was also shaky so the November 830 puts were 60 cents on Monday, Tuesday and Wednesday but rose to 1.20 Thursday and 2.40 on Friday. The Hang Seng dropped over 20 per cent in a short period including a 10 per cent drop on Friday, October 25th. The S&P500 was at 976 way above 830 as of Friday's close. A further 5 per cent drop on Monday, October 27 in Hong Kong led to a panic in the S&P500 later on Monday in the US. The fall was 7 per cent from 976 to 906 which was still considerably above 830. On Tuesday, there was a further fall of 3 per cent to 876 still keeping the 830 puts out of the money.

But the volatility exploded and the 830s were in the $16 area. Refco called in Niederhoffer's puts mid morning. They took a loss of about $20 million. So Niederhoffer's $70 million fund was bankrupt and actually in the red. The S&P500 bottomed out around the 876 area moved violently in a narrow range then settled and then moved up by the end of the week back to the 976 area. The November 830 puts expired worthless. Investors who had equity November 830s were required to put up so much margin that that forced them to have small positions and they weathered the storm and their $4-$6, while temporarily behind at $16 did go to zero. So did the futures puts, but futures shorters are not required to post as much margin so if they did not have adequate margin because they had too many positions, they could have easily been forced to cover at a large loss. One of my neighbors, I learned later, lost $16 million in one account and $4 million in another account. The difference being the time given to cash out and cover the short puts. I was in this market also and won in the equity market and lost in futures. It did teach me how much margin you actually need in futures which I use now in such trading which has been very profitable with a few wrinkles to protect oneself that I need to keep confidential. One of the strategies won 64 out of 65 times from 1987 to 2003 and a hedged strategy had a 45 per cent geometric mean with 60 of 65 winners with five ruled too risky in each case out of 70 possible plays.

The lessons for hedge funds are much as with LTCM. Do not overbet, do diversify, watch out for extreme scenarios. Even the measure to keep one out of potentially large falls did not work in October 1997. That was an imported fear-induced crash not really based on economics. My experience is that most crashes occur when interest rates relative to price earnings ratios are too high. In that case there almost always is a crash, see Ziemba (2003) for 1987 US, 1990 Japan, 2000 US, the leading examples. But a mini crash caused by some extraneous event can occur any time. So to protect oneself positions must not be too large. Koliman (1998) and Cranby, Gabi and Mark in Gibson's (2000) fine book on model risk discuss this. Their analysis there suggests it's a violation of lognormality which I agree it was.

Average net returns both absolute and risk-adjusted are significantly lower in the presence of incentive fees

Increased implied volatility premiums caused the huge losses of those who had to cash out because of margin calls because they had too many positons.

Some good references on hedge fund performance, risk and incentives follow for further reading. Kouwenberg and Ziemba (2003) using a continuous-time model with a prospect theory objective, where losses are more important than gains, study the effect of incentives on hedge fund manager behavior. The incentive fee encourages managers to take excessive risk but that risk is much less if the fund manager has a substantial amount of their own money in the fund. So look for funds where the managers *eat their own cooking*. Their empirical results indicate that hedge funds with incentive fees have higher downside risk than funds without such a compensation contract. Average net returns both absolute and risk-adjusted are significantly lower in the presence of incentive fees.

An incentive fee is tantamount to a call option on the value of the investor's assets. Goetzmann, Ingersoll and Ross (2003) and Kouwenberg and I show how to calculate the value of that option. We find that the value depends directly on the manager's optimal investment style with values from 0.8 per cent to 17 per cent of the investor's capital.

In my next column, I will formulate some stochastic programming models and discuss pension fund applications. Wallace and Ziemba (2003) is for those who would like to learn how to make such models and Ziemba (2003) is for those who would like to understand enough about these models to hire someone to make one for you. Ziemba and Mulvey (1998) describe many such existing models for insurance, pension fund and other applications. The Lo (1999, 2001) and Merton (2000a,b) papers are useful to set the stage for the stochastic programming models by setting out the issues.

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