CHAPTER 22

HOW TO LOSE MONEY IN DERIVATIVES: EXAMPLES FROM HEDGE FUNDS AND BANK TRADING DEPARTMENTS*

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Abstract: What makes futures hedge funds fail? The common ingredient is over betting and not being diversified in some bad scenarios that can lead to disaster. Once troubles arise, it is difficult to take the necessary actions that eliminate the problem. Moreover, many hedge fund operators tend not to make decisions to minimize losses but rather tend to bet more doubling up hoping to exit the problem with a profit. Incentives, including large fees on gains and minimal penalties for losses, push managers into such risky and reckless behavior. We discuss some specific ways losses occur. To illustrate, we discuss the specific cases of Long Term Capital Management, Niederhoffer's hedge fund, Amaranth and Société Générale. In some cases, the failures lead to contagion in other hedge funds and financial institutions. We also list other hedge fund and bank trading failures with brief comments on them.

Keywords: Hedge fund trading disasters, over-betting, Long Term Capital Management, Amarath and Société Générale.

Understanding How to Lose Helps One Avoid Losses!

We begin by discussing how to lose money in derivatives which leads to our discussion of hedge fund disasters and how to prevent them. The derivative futures industry deals with products in which one party gains what the other party loses. These are zero sum games situations. Hence there will be large winners and large losers. The size of the gains and losses are magnified by the leverage and overbetting, leading invariably to large losses when a bad scenario occurs. This industry now totals over $700 trillion of which the majority is in interest and bond derivatives with a smaller, but

*Some of the material in this chapter is adapted from chapters in Ziemba and Ziemba (2013) which were modified updates of columns originally published in *Wilmott*.

substantial, amount in equity derivatives. Figlewski (1994) attempted to categorize derivative disasters and this chapter discusses and expands on that:

1. *Hedge*
   In an ordinary hedge, one loses money on one side of the transaction in an effort to reduce risk. To evaluate the performance of a hedge one must consider all aspects of the transaction. In hedges where one delta hedges but is a net seller of options, there is volatility (gamma) risk which could lead to losses if there is a large price move up or down and the volatility rises. Also accounting problems can lead to losses if gains and losses on both sides of a derivatives hedge are recorded in the firm's financial statements at the same time.
2. *Counterparty default*
   Credit risk is the fastest growing area of derivatives and a common hedge fund strategy is to be short overpriced credit default derivatives. There are many ways to lose money on these shorts if they are not hedged correctly, even if they have a mathematical advantage. In addition, one may lose more if the counterpart defaults because of fraud or following the theft of funds, as was the case with MF Global.
3. *Speculation*
   Derivatives have many purposes including transferring risk from those who do not wish it (hedgers) to those who do (speculators). Speculators who take naked unhedged positions take the purest bet and win or lose monies related to the size of the move of the underlying security. Bets on currencies, interest rates, bonds, and stock market index moves are common futures and futures options trades.

   Human agency problems frequently lead to larger losses for traders who are holding losing positions that if cashed out would lead to lost jobs or bonus. Some traders increase exposure exactly when they should reduce it in the hopes that a market turnaround will allow them to cash out with a small gain before their superiors find out about the true situation and force them to liquidate. Since the job or bonus may have already been lost, the trader's interests are in conflict with objectives of the firm and huge losses may occur. Writing options, and more generally selling volatility or insurance, which typically gain small profits most of the time but can lead to large losses, is a common vehicle for this problem because the size of the position accelerates quickly when the underlying security moves in the wrong direction as in the Niederhoffer example below. Since trades between large institutions frequently are not

collateralized mark-to-market, large paper losses can accumulate without visible signs such as a margin call. Nick Leeson's loss betting on short puts and calls on the Nikkei is one of many such examples. The Kobe earthquake was the bad scenario that bankrupted Barings.

A proper accounting of trading success evaluates all gains and losses so that the extent of some current loss is weighed against previous gains. Derivative losses should also be compared to losses on underlying securities. For example, from January 3 to June 30, 1994, the 30-year T-bonds fell 13.6%. Hence holders of bonds lost considerable sums as well since interest rates rose quickly and significantly.

4. *Forced liquidation at unfavorable prices*
Gap moves through stops are one example of forced liquidation. Portfolio insurance strategies based on selling futures during the October 18, 1987 stock market crash were unable to keep up with the rapidly declining market. The futures fell 29% that day compared to −22% for the S&P500 cash market. Forced liquidation due to margin problems is made more difficult when others have similar positions and predicaments and this leads to contagion. The August 1998 problems of Long Term Capital Management (LTCM) in bond and other markets were more difficult because others had followed their lead with similar positions. When trouble arose, buyers were scarce and sellers were everywhere. Another example is Metallgellschaft's crude oil futures hedging losses of over $1.3 billion, which is discussed below. They had long-term contracts to supply oil at fixed prices for several years. These commitments were hedged with long oil futures. But when spot oil prices fell rapidly, the contracts to sell oil at high prices rose in value but did not provide current cash to cover the mark-to-the-market futures losses. A management error led to the unwinding of the hedge near the bottom of the oil market and the disaster.

Potential problems are greater in illiquid markets. Such positions are typically long-term and liquidation must be done matching sales with available buyers. Hence, forced liquidation can lead to large bid-ask spreads. Askin Capital's failure in the bond market in 1994 was exacerbated because they held very sophisticated securities which were only traded by very few counterparties, so contagion occurred. Once they learned of Askin's liquidity problems and weak bargaining position, they lowered their bids even more and were then able to gain large liquidity premiums.

5. *Misunderstanding the risk exposure*
As derivative securities have become more complex, so has their full understanding. The Shaw *et al.* (1995) Nikkei put warrant trade

(discussed in Ziemba and Ziemba (2013), Chapter 12) was successful because we did a careful analysis to fairly price the securities. In many cases, losses are the result of trading in high-risk financial instruments by unsophisticated investors. Lawsuits have arisen by such investors attempting to recover some of their losses with claims that they were misled or not properly briefed on the risks of the positions taken. Since the general public and thus judges and juries find derivatives confusing and risky, even when they are used to reduce risk, such cases or their threat may be successful.

A great risk exposure is the extreme scenario which often investors assume has zero probability when in fact they have low but positive probability. Investors are frequently unprepared for interest rate, currency or stock price changes so large and so fast that they are considered to be impossible to occur. The move of some bond interest rate spreads from 3% a year earlier to 17% in August/September 1998 led even savvy investors and very sophisticated Long Term Capital Management researchers and traders down this road. They had done extensive stress testing with a VaR risk model which failed as the extreme events such as the August 1998 Russian default had both the extreme low probability event plus changing correlations. Several scenario-dependent correlation matrices rather then simulations around the past correlations from one correlation matrix is suggested. This is implemented, for example, in the Innovest pension plan model which does not involve levered derivative positions (see Ziemba and Ziemba, 2013, Chapter 14). The key for staying out of trouble especially with highly levered positions is to fully consider the possible futures and have enough capital or access to capital to weather bad scenario storms so that any required liquidation can be done orderly.

Figlewski (1994) observes that the risk in mortgage-backed securities is especially difficult to understand. Interest only (IO) securities, which provide only the interest part of the underlying mortgage pool's payment stream, are a good example. When interest rates rise, IOs rise since payments are reduced and the stream of interest payments is larger. But when rates rise sharply, the IO falls in value like other fixed-income instruments because the future interest payments are more heavily discounted. This signal of changing interest rate exposure was one of the difficulties in Askin's losses in 1994. Similarly the sign change between stocks and bonds during stock market crashes as in 2000 to 2003 has caused other similar losses. Scenario-dependent matrices are especially useful and needed in such situations.

6. *Forgetting that high returns involve high risk*
   If investors seek high returns, they will usually have some large losses. The Kelly criterion strategy and its variants provide a theory to achieve very high long-term returns, but large losses will also occur. These losses are magnified with derivative securities and especially with large derivative positions relative to the investor's available capital.
7. *How over-betting occurs*
   Figure 22.1 shows how the typical over-bet situation occurs assuming a Kelly strategy is being used. The top of the growth rate curve is at the full Kelly bet level that is the asset allocation maximizing the expected value of the log of the final wealth subject to the constraints of the model. To the left of this point are the fractional Kelly strategies which under a lognormal asset distribution assumption use a negative power utility function rather than log. So αw^{α} for $\alpha < 0$ gives the fractional Kelly weight $f = \frac{1}{1-\alpha}$. So $u(w) = \frac{-1}{w}$ corresponds to $\frac{1}{2}$ Kelly with $\alpha = -1$. Overbetting is to the right of the full Kelly strategy and it is clear that betting more than full Kelly gives more risk measured by the probability of reaching a high goal before a lower level curve on the figure. It is this area way to the right where over-betting occurs. And virtually all of the disasters occur because of the over-betting.

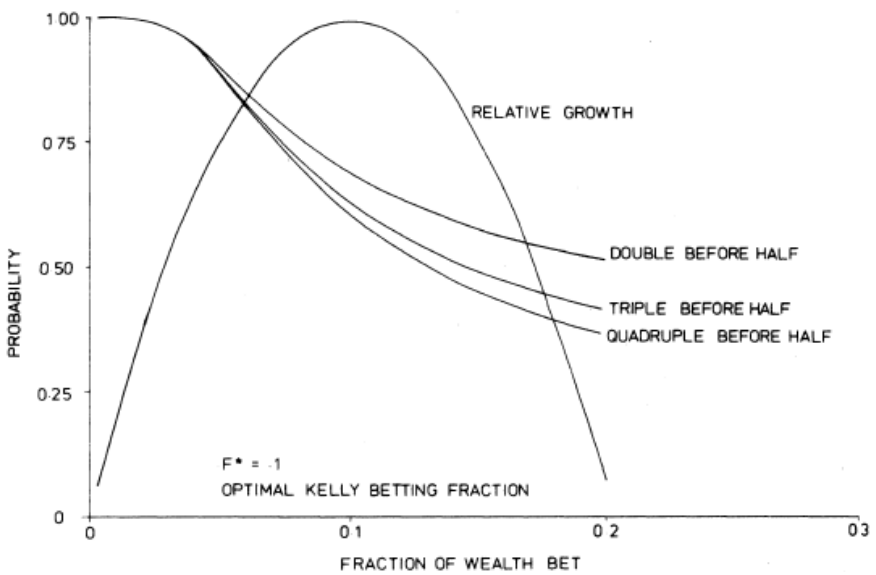


Figure 22.1. Relative growth and probabilities of doubling, tripling, and quadrupling initial wealth for various fractions of wealth bet for the gamble win \$2 with probability 0.4 and lose \$1 with probability 0.6.

It is easy to over-bet with derivative positions as the size depends on the volatility and other parameters and is always changing. So a position safe one day can become very risky very fast. A full treatment of the pros and cons of Kelly betting is in Ziemba (2014).

Stochastic programming models provide a good way to try to avoid problems 1–6 by carefully modeling the situation at hand and considering the possible economic futures in an organized way.

Hedge fund and bank trading disasters usually occur because traders over-bet, the portfolio is not truly diversified and then trouble arises when a bad scenario occurs. We now discuss a number of sensational failures including Metalgesllshart (1993), LTCM (1998), Niederhoffer (1997), Amaranth Advisors (2006), Merrill Lynch (2007), Société Générale (2008), Lehman (2008), AIG (2008), Citigroup (2008), MF Globl (2012), and Monti dei Paschi (2013). 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. 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. Ziemba and Ziemba (2013, Chapter 14) explores more deeply such models in the context of pension fund as well as hedge fund management.

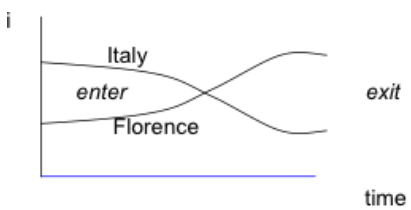
Litzenberger and Modest (2009), who were on the firing line for the LTCM failure, propose a modification of standard finance CAPM type theory modified for fat tails and CVaR or expected tail losses for the losses. Ziemba (2003, 2007, 2013) presents his approach using convex risk measures and three scenario-dependent correlation matrices depending upon volatility using stochastic programming scenario optimization. Both of these approaches would mitigate such losses. The key is not to over-bet and have access to capital once a crisis occurs and to plan in advance for such events.

The Failure of Long Term Capital Management (1998)

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 the Salomon Brothers who were very successful for a number of years. When Warren Buffett came on board at Salomon, the culture of this group clashed with Buffett's apparently more conservative style. In truth, Buffett's record is Kelly like (see Ziemba, 2014) and not all that different from Merriwether's group in terms of position size but Buffett's risk control is superior. He always has lots of cash to bail out any troubling trades. 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% of profits plus a 3% management expense fee), and entry investment was $100 million minimum. The idea, according to Myron Scholes, was to be a big vacuum cleaner sucking up nickels all over the world as the cartoon suggests. There were many trades, but the essence of the bond risk arbitrage was to buy underpriced bonds in various locales, sell overpriced bonds in other locales, wait for the prices to revert to their theoretical efficient market prices, and then unwind the position.

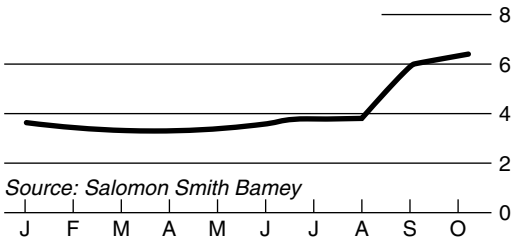
These trades are similar to the Nikkei put warrant risk arbitrage Thorp and Ziemba did except that the leverage they used was much much greater (Shaw *et al.*, 1995). We can call these bond trades *buy Italy and sell Florence.* As shown in the graph, the interest rate implied by the bond prices is higher 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 was that markets were efficient and, when temporarily out of whack, would snap back quickly. The continuous lognormal assumptions of option pricing hedging led them to take very large positions which according to their theory were close to riskless.



Buy Italy, sell Florence

The plan worked and net returns for the part of the year 1994 that the fund operated were 19.9% net. The years 1995 and 1996 had similar high returns of 42.8% and 40.8% net, respectively. Indeed for the principals whose money grew fee-less, the net returns were 63% and 57%, respectively, with taxes deferred. There was so much demand for investment in the fund, which in 1997 was effectively closed to new investors, that a grey market arose with a 10% premium. By 1997, it became harder to find profitable trades and the gains fell to 17.1%. This was a good record for most but not satisfactory to LTCM's principals; among other things the S&P500 returned 31% excluding dividends. Their action was to return $2.7 billion of the $6.7 billion to the investors, a huge mistake! The principals then put in an additional $100 million raised by personal bank loans, another mistake. The banks were happy to lend this money basically unsecured. Banks and others were quite keen to loan to or invest with this group and the investors were not happy to be forced out of the fund. Still, at the start, $1 on February 24, 1994, was $2.40 net at the end of 1997. The year 1998 was difficult for the fund and then turned into a disaster following the August 17 Russian ruble devaluation and sovereign 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 percent as they were not subject to the effects of the ruble devaluation. So long 60 short 95 say became long 3 short 92 say. Also there were defaults in currency hedging contracts which added to the losses because that hedge failed.

Such losses occur from time to time in various markets, and hedge funds which over-bet can be particularly vulnerable to it. The problem for LTCM was that they had $1.25 trillion of positions in notional value (that was over 2% of the world's derivatives in 1998) with a market value of $129 billion financed by $125 billion of borrowed money. They had $4 billion in equity with a leverage ratio of 32. Although the trades were all over the world and hence it seemed they were diversified, they in fact were not. What happened was a scenario-dependent correlation situation like that modeled in the Innovest pension fund application described in Ziemba and Ziemba (2013), Chapter 14. There was an underlying variable that frequently lurks its ugly head in disasters that being investor confidence. The graph on the side illustrates the problem: all the bond rates increased for non-high quality debt. For example, emerging market debt was trading for 3.3% above U.S. T-bonds in October 1997, then 6% in July 1998 and then an astounding 17% in September 1998.



The spread between emerging market debt and U.S. T-bonds, 1998

LTCM was unable to weather the storm of this enormous crisis of confidence and lost about 95% 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 two Nobel Prize winners Robert Merton and Myron Scholes recommended, nor that many other copy-cat firms had similar positions, nor that LTCM had created enemies by being so skilled and so brash, nor that the lack of monitoring of margin by brokers eager for their business allowed the positions to grow to over-bet levels. A pivotal decision was returning $2.7 billion to investors. They could have kept the funds in liquid low-risk assets to buffer their mounting losses. However had they kept the funds they might have made even more risky plays. Returning this money reflected their greediness. They simply wanted to make a higher rate of return with similar positions on a smaller capital base.[1] Smart people bounce back and possibly learn from their mistakes. Various ex-LTCM members have joined new hedge funds and other ventures. The lessons are:

- Do not over-bet, it is too dangerous.
- VaR type systems are inadequate to measure true risk but see Jorion's (2007) excellent book on VaR and Dunbar's (2000) discussion of the VaR calculations used by LTCM. LTCM analysts did a very careful analysis but the problem was that the risk control method of VaR which is used in

[1]Using the Kelly criterion, you should never bet more than the log optimal amount and betting more (as LTCM did) is dominated as it has lower growth rates *and* higher risk. This point is **not** understood by even the top academic financial economists who insist on using positive power as well as negative power and log utility functions. The positive power ones are dominated and reflect over-betting.

regulations does not really protect hedge funds that are so highly levered because you are not penalized enough for large losses. Indeed if you lose \$10 million, it is penalized the same as losing \$100 million if the VaR number is \$9 million of losses. CVaR partially addresses this limitation but what you really need are convex penalties so that penalties are more than proportional to losses.

- You really do need to use scenario-dependent correlation matrices and consider extreme scenarios. LTCM was not subject to VaR regulation but still used it.
- Be aware of and consider extreme scenarios.
- Allow for extra illiquidity and contract defaults. LTCM also suffered because of the copycat firms which put on similar positions and unwound them at the same time in August/September 1998.
- Really diversify (to quote Soros from the Quantum Funds, "we risked 10% of our funds in Russia and lost it, \$2 billion, but we are still up 21% 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. Sorry to be repetitive, but this is crucial.

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 André Perold (1998), and articles by Philippe Jorion (2000) and Franklin Edwards (1999). Eventually the positions converged and the bailout team was able to emerge with a profit on their investment.

The currency devaluation of some two-thirds was no surprise to WTZ. In 1992, we 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 WTZ was the series editor. On arrival, I gave him a \$100 bill and he gave me four inches of 25 Ruble notes. Our dinner out cost two inches for the four of us; and drinks were extra in hard currency. So we are in the Soros camp; make bets in Russia (or similar risky markets) if you have an edge without risking too much of your wealth. Where was the money lost? The score card according to Dunbar (2000) was a loss of \$4.6 billion. Emerging market trades such as those similar to the *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% versus implieds of about 22%. Unfortunately, in the bad scenario, the implieds reached 30% and then 40%. With smaller positions, the fund could have waited it out but with such huge levered positions, it could not. Equity implieds can reach 70% or higher as Japan's Nikkei did in 1990/1991 and stay there for many months.

Niederhoffer's Hedge Fund Disaster and the Imported Crash of October 27 and 28, 1997

The Asian Financial crises was a series of banking and currency crises that developed in various Asian countries beginning in mid-1997. Many East and Southeast Asian countries had currency pegs to the U.S. dollar which made it easy for them to attract financing but lacked adequate foreign reserves to cover the outstanding debt. Their pegs to the U.S. dollar and low interest rates encouraged mismatches in currency (debts were in U.S. dollars, loans in local currency) and maturities. Spending and expectations that led to borrowing were too high and Japan, the main driver of these economies, was facing a consumer slowdown so its imports dropped, so that effectively these countries were long yen and short dollars. A large increase in the U.S. currency in yen terms exacerbated the crisis, which began after speculators challenged the Thai Baht and spread through the region. The countries had to devalue their currencies, interest rates rose, and stock prices fell. Also, several hedge funds took significant losses. Most notably, Victor Niederhoffer's fund, which had an excellent previous record with only modest drawdowns, but his large long bet on cheap Thai stocks that became cheaper and cheaper quickly turned $120 million into $70 million. Further buying on dips added to losses. Finally the fund created a large short position in out-of-the-money S&P futures index puts including the November 830's trading for about $4–6 at various times around August–September 1997.

The crisis devastated the economies of Malaysia, Singapore, Indonesia, etc. Finally it spread to Hong Kong, where the currency was pegged to the U.S. dollar at 7.8. The peg supported Hong Kong's trade and investment hub and was to be defended at all costs. In this case, the weapon used was higher interest rates which almost always lead to a stock market crash after a lag; see Lleo and Ziemba (2012). The U.S. S&P500 was not in the danger

zone in October 1997 by WTZ's models nor, we presume, by those of others. Also, trade with Hong Kong and Asia, though substantial, was only a small part of the U.S. trade. Many U.S. investors thought that this Asian currency crisis was a small problem because it did not affect Japan very much. In fact, Japan caused a lot of it.

A wild week, October 20–25, 1997

The week of October 20–25, 1997 was difficult for equity markets with the Hang Seng dropping sharply. The S&P was also shaky. The November 830 puts were 60 cents on Monday, Tuesday, and Wednesday but rose to 1.20 on Thursday and 2.40 on Friday. The Hang Seng dropped over 20% in a short period including a 10% drop on Friday, October 25. The S&P500 was at 976 substantially above 830 as of Friday's close. A further 5% drop in Hong Kong on Monday, October 27 led to a panic in the S&P500 futures later on Monday in the United States. They fell 7% from 976 to 906 which was still considerably above 830. On Tuesday morning, there was a further fall of 3% to 876 still keeping the 830 puts out of the money. The full fall in the S&P500 was then 10%.

But the volatility Exploded and the 830's climbed to the $16 area. Refco called in Niederhoffer's puts mid-morning on Tuesday, resulting in the fund losing about $20 million. So Niederhoffer's $70 million fund was bankrupt and actually in the red as the large position in these puts and other instruments turned the $70 million into minus $20 million. The S&P500 bottomed out around 876, moving violently in a narrow range, then settling. By the end of the week, it returned to the 976 area. So it really was a tempest in a teapot. Investors who were short equity November 830 puts (SPXs) were required to put up so much margin that they had small positions so they weathered the storm. Their $4–$6, while temporarily behind at $16, did eventually go to zero. So did the futures puts, but futures shorters are not required to post as much margin. 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. Futures margins, at least for equity index products, do not fully capture the real risk inherent in these positions. We follow closely the academic studies on risk measures and none of the papers we know address this issue properly. When in doubt, always bet less. Niederhoffer is back in business having profited by this experience. (Whoops — maybe not, see the postscript!)

One of Ziemba's Vancouver neighbors 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. Ziemba was in this market also and won in the equity market and lost in futures. I did learn how much margin you actually need in futures which now Ziemba uses in such trading which has been very profitable with a few proprietary wrinkles to protect oneself that he needs to keep confidential. A hedged strategy had a 45% geometric mean with 72 of 77 winners with six quarters ruled too risky by an option price market sentiment danger control measure out of the 83 possible plays in those 22 years and a seven symmetric downside Sharpe ratio. Ruling out the six risky quarters, one of the naked strategies won 76 out of 77 times from 1985 to 2006. In those six quarters, the S&P500 actually fell in four. The cumulative S&P500 loss in the six quarters was −41.7%.

The lessons for hedge funds are much as with LTCM. Do not over-bet, do diversify, watch out for extreme scenarios. Even the measure to keep one out of potentially large falls mentioned above did not work in October 1997. That was an imported fear-induced stock market crash which was not really based on the U.S. economy or investor sentiment. Most crashes occur when interest rates relative to price earnings ratios are too high. Almost always when that happens, there is a crash (a 10% plus fall in equity prices from the current price level within one year); see Ziemba (2003) and Lleo and Ziemba (2012) for the 1987 U.S., the 1990 Japan, the U.S. in 2000, the U.S. in 2001, which predicted the 22% fall in the S&P500 in 2002 and China, Iceland and the U.S. in 2006–2009 are leading examples. Interestingly the measure moved out of the danger zone following the 2000 crash. Then, in mid-2001, it was even more in the danger zone than in 1999 because stock prices fell but earnings fell more. In 2003, the measure then moved into the buy zone and predicted the rise in the S&P500 in 2003. No measure is perfect but this measure adds value and tends to keep you out of extreme trouble.

When long bond interest rates get too high relative to stock returns as measured by the earnings over price yield method, there almost always is a crash. Ziemba–Schwartz (1991) used a difference method and the results of that are in Ziemba (2003). Ziemba started using these measures in 1988 in my study group at Yamaichi Research, Japan. The study predicted the 1987 crash. It also predicted the 1990 Japan crash. Ziemba told Yamaichi executives about this in 1989, but they would not listen. Yamaichi went bankrupt in 1995; they would have survived if they had listened.[2] From

[2]They could have paid WTZ a million dollars for an hour's consulting and still made more than 1000 times profit from the advice. It was more important for them to be nice to his family and him as they were than to listen to the results of a *gaijin* professor. How could

1948 to 1988, every time that the measure was in the danger zone there was a fall of 10% or more with no misses. This was 12 of 12 with 8 other 10%+ crashes occurring for other reasons than high interest rates relative to earnings. In late 1989, the model had the highest reading ever in the danger zone and predicted the January 1990 start of the Japanese stock market crash.

A mini-crash caused by some extraneous event can occur any time. So to protect oneself, positions must *never* be too large. Koliman (1998) and Crouhy, Galai, and Mark in Gibson's (2000) book on model risk discuss this. Their analysis suggests it is a violation of lognormality which I agree it was. Those who had too many positions had to cash out and suffer large losses because they had to satisfy the increased margin required due to the drop in price and the increase in implied volatility.

Some good references on hedge fund performance, risk and incentives follow for further reading. Kouwenberg and Ziemba (2007) using a continuous time model with a prospect theory S-shaped objective, where losses are more damaging than gains are good, 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 (at least 30%). This suggests that investors should look for funds where the managers *eat their own cooking*.[3] 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. So pick your managers well.

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 Ziemba (2007) show how to calculate the value of that option. The value depends directly on the manager's optimal investment style with values ranging from 0 (with no investment) to 17% (with 30%+ share) of the investor's capital.

he possibly understand the Japanese stock market? In fact all the economics ideas were there; see Ziemba and Schwartz (1991). WTZ did enjoy these lectures, dinners, and golf but being listened to dominates.

[3]But the manager's personal share of the fund may decline in percentage term as the fund grows!

Overbetting Yields Frequent Trading Disasters

"*The best way to achieve victory is to master all the rules for disaster, and then concentrate on avoiding them.*
In America, people get a second chance . . . they don't get a third."

Victor Niederhoffer

After Niederhoffer's failure in 1997, his fund was closed and he lost much of his personal fortune, reputation, and happiness. He had failed in 1997 because he greatly over-bet, did not diversify, and a bad scenario wiped him out. Was this a one-time occurrence from which he learned or is it just one of a sequence of similar outcomes? Niederhoffer is a multi-talented individual graduating with a PhD in 1969 from the Graduate School of Business, at the University of Chicago where Professor Gene Fama, Merton Miller, and other great finance theorists and practitioners are on the faculty. Since his work was against the prevailing efficient markets theory and was highly data-dependent, he was more comfortable with the statisticians and was supervised by perhaps the world's top Bayesian statistician, Arnold Zellner. Earlier at Harvard, his senior thesis "Non-randomness in stock prices: A new model of price movements" challenged random walk theory. He argued that stocks followed patterns such as Monday falls if Friday fell.

In 1967, with his PhD thesis unfinished and the title "U.S. top squash player," he headed to the finance department of the University of California, Berkeley Business School. WTZ was there then as well but never met Niederhoffer, being a graduate student. Victor was also a whiz at chess and tennis, dating back to his Harvard undergraduate days. WTZ was friendly with one finance legend Professor Barr Rosenberg who went on to greatness in a number of investment areas such as founding the Berkeley Program in Finance, the firm BARRA and later Rosenberg Investments. Both Barr and Victor, like WTZ, were looking for anomalies to beat markets. In 1967, Barr discovered that small caps and low price to book stocks outperformed the broad market. This observation forms the basis of the famous Fama-French (1992) factors 25 years later; see Rosenberg, Reid and Lanstein (1985). While Barr stuck to institutional investing with low or no leverage, Victor was a high-stakes futures trader using lots of leverage. Hence, if he was right, then the gains were very high but if he was wrong and his risk control was faulty, then there could be substantial losses.

Table 22.1. Performance of the Matador Fund, February 2002–April 2006 and Manchester Fund from March 2005–April 2006. First line is Assets, MM, second line is Monthly Return.

	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	NOV	DEC	YRTTL
Matador Fund													
2006	261.24	280.26	304.72	346									
	9.59%	6.46%	7.58%	4.70%									
2005	112.24	123.72	125.72	122.02	132.43	139.59	149.88	151.81	164.34	194.05	219.11	236.75	236.75
	1.87%	3.76%	1.62%	−12.70%	20.66%	5.40%	7.72%	1.29%	8.25%	−5.42%	10.05%	6.59%	56.28%
2004	56.37	54.83	56.85	60.21	61.96	63.3	65.28	67.49	75.02	77.95	105.28	110.17	110.17
	1.22%	8.35%	0.20%	5.17%	4.04%	2.15%	3.22%	3.38%	2.98%	3.90%	3.26%	3.67%	50.13%
2003	21.15	31.13	35.17	40.46	41.9	42.94	45.26	46.11	46.44	49.18	50.08	55.69	55.69
	2.47%	7.70%	1.65%	1.76%	3.54%	2.48%	4.75%	1.32%	0.52%	5.91%	1.21%	1.48%	40.55%
2002		2.03	2.92	3.64	5.5	11.81	8.65	8.12	8.88	10.22	10.66	12.54	12.54
		1.71%	2.71%	−0.65%	10.01%	−1.16%	−30.22%	−6.81%	9.29%	15.20%	3.55%	7.86%	3.12%
Manchester Fund													
2006	13.9	15.90	17.32										
	10.61%	7.44%	8.24%										
2005	n/a	n/a	2	1.94	2.72	4.4	4.73	5.86	6.6	7.82	8.99	11.07	1.07
	n/a	n/a	n/a	−3.10%	11.68%	4.09%	7.50%	−0.59%	9.69%	−4.36%	14.98%	5.53%	53.23%

Source: Manchester Trading, LLC (2006).

While teaching at Berkeley, Victor co-founded a small investment bank, Niederhoffer, Cross and Zeckhauser (NCZ). Frank Cross was a former Merrill Lynch executive and Richard Zeckhauser, a friend from his Harvard days. Zeckhauser went on to become a well known economist at the Kennedy School of Government and an avid bridge player. NCZ started with just $400, did mail-order mergers, and sold small private companies to buyers. In 1979, Niederhoffer went into commodities and had great success, averaging 35% net for 15 years through the mid-1990s. George Soros gave him a private $100 million account in 1981 and Niederhoffer traded that until 1993. This account was shut down because, as Soros said, "he temporarily lost his edge ... he made money while the markets were sloshing along aimlessly. Then he started losing money and had the integrity to close out the account. We came out ahead." Earlier in 1983, Zeckhauser had quit NCZ to return to full-time teaching and research partially because of Niederhoffer's high level of risk taking, saying that "no matter what your edge, you can lose everything. You hope and believe he will learn his lesson." Cross died and NCZ became Niederhoffer Henkel and was then run by Lee Henkel, the former general council for the IRS.

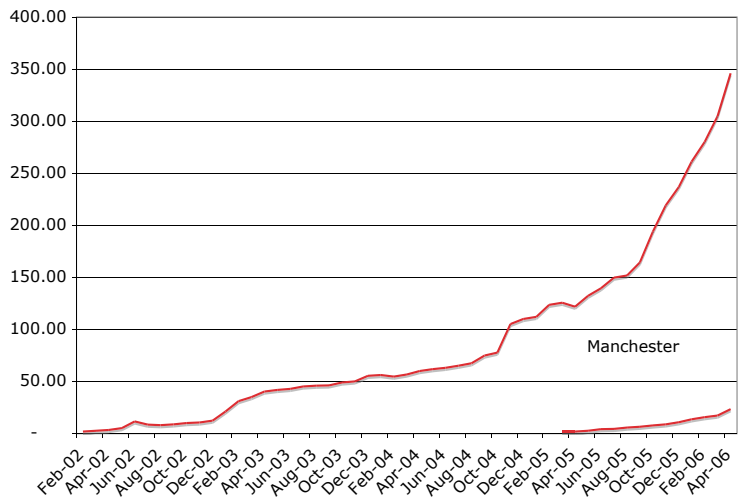
After the 1997 blowout, it was hard for Niederhoffer to start again as there was fear of another large drawdown despite his long superior track record. So he began trading for his own account after mortgaging his house. In 2000 he started writing investment columns on websites with Laurel Kenner and in 2001 it paid off. Mustafa Zaida, a Middle East investor, set up the offshore hedge fund Matador with $2 million and recruited Niederhoffer as the trading advisor. To reign in Niederhoffer's exuberance for risk, the fund would invest only in U.S.-based S&P500 futures and options. The claim was that Niederhoffer had learned his lesson not to invest in markets he did not understand like Thailand which got him on the road to destruction in 1997. A management fee of 2.5% + 22% of the net new profits was substantial. Yet with good performance, Matador grew to $350 million from non-U.S. investors. Zaida said that "He's definitely learned his lesson." Recall that it was the S&P500 November largely 830 puts that turned $70 million into −$20 million in 1997 after $50 million was lost in Thai equities. Niederhoffer always thinks big and bold, so Matador was not enough. In April 2005, Niederhoffer started Manchester Partners, LLC for U.S. investors, named for the Silver Cup given to the winner of the Manchester Cup Steeplechase in 1904. This trophy was one of the many art objects Niederhoffer had collected over the years and hung onto. Manchester's fees were 1%+20%, and could trade other than the S&P500 market such as fixed income and

currencies. Steve "Mr Wiz" Wisdom was Niederhoffer's risk control aide, hoping to have consistent 25%+ returns with maximum losses of 15–20% in one month. The bond-stock crash measure (Ziemba, 2003; Lleo and Ziemba, 2012), flagged a red signal at the end of 2001 because earnings dropped more than stock prices. Ziemba's confidential investor sentiment model based on relative put/call option prices flashed red in Q4 of 2002. And indeed there was a substantial fall in the S&P500 in July 2002; Matador lost 30.22% in that month.

Still the February 2002 to April 2006 Matador record was a +338% gain, 41% net annualized, $350 million in assets and only 5 losses in 51 months, with a 2.81 Sharpe ratio (see Figure 22.2). This record earned Matador the #1 ranking in 2004, 2005, and 2006 for funds managing $50+ million (see Table 22.2).

Manchester had only three monthly losses in the 13 months from its start in April 2005 to April 2006, a cumulative gain of 89.9%. The approach had the following elements (from Manchester Trading, 2006):

Scientific Rigorous statistical methodologies form the foundation of our proprietary pattern recognition process.



(a) Assets, MM

Figure 22.2. Performance of the Matador fund, February 2002–April 2006 and Manchester fund from March 2005–April 2006.

Source: Manchester Trading, LLC (2006).

(b) Monthly Returns, %

Figure 22.2b. (*Continued*).

Table 22.2. Ranking of Manchester trading.

2006	#1 performing CTA MarHedge MAPA.
2005	#1 offshore managed futures fund (Tass/Lipper) for funds managing more than $50 million.
2004	#1 offshore managed futures (Tass/Lipper) for funds managing more than $50 million. Cumulative +338% since inception in February 2002: Assets under management $350+ million.

Source: Manchester Trading, LLC (2006).

Empirical "What can be tested, must be tested." Validation through testing is the basis for all trade recommendations, impact planning, and margin assessment.

Innovative Multidisciplinary inquiry draws from such diverse fields as speech processing, information theory, and data compression to provide insight and inspiration.

Contrarian Crowd behavior tends to create profitable opportunities. We are more often than not counter-trend traders.

Focused Undiluted application of our edge leaves the critical diversification decision in the hands of our investors.

For short-term discretionary day trading:

- Systematic identification of high-probability trades
- Analysis across multiple markets and multiple time frames
- Flexible analytical methodology sensitive to changing cycles
- Tactical execution reducing friction and slippage

And for the option trading:

- Empirical option pricing vs. implied volatility method
- Strategic/opportunistic seller of expensive premium
- Forecasting techniques applied to margin pathways enhancing risk modeling
- Flexible position across multiple strikes and timeframes
- Highly sensitive ongoing measurement of overall liquidity and margin pathway forecasting refines leverage assessment

And what did they learn from the 1997 blowout?

- We learned our lesson and got back on our feet **fast**.
- We stick with markets and instruments we know.
- We focus on liquidity.
- We are alert to the increasing probability of extreme events, measure their potential impact, and prepare for them.
- We implement safeguards and continue to refine trading and risk assessment procedures to ensure survival.

They say it cannot happen again because

- We tailor our risk profile at all times cognizant of the impact and opportunity extreme events can bring about.
- We are constantly innovating but remain focused on what works empirically. We don't stray from our core strategy.
- Substantial co-investment by the principals of the firm is the most powerful statement we can possibly make with regard to our long-term commitment to our partners.

Manchester does not like to diversify and their literature says that

> We choose not to diversify or manage the volatility of our fund to a benchmark or index as we believe our clients and their asset allocation advisors are in a far better position to make accurate and economical diversification decisions than we are. (Manchester, 2006)

Niederhoffer has historically had a long bias in his trades which are frequently unrad with 3–6 times leverage with borrowed money.

On May 10, 2006, the Russian New Europe (RNE) fund, was trading at a 37% premium to net asset value according to the *Barron's*. RNE treated WTZ well over the years with high returns and generous capital gains and dividends. But a 37% premium was extraordinary. The bond-stock model and the short-term investor sentiment option models WTZ uses were both way out of the danger zone and did not predict the subsequent decline. That weekend was a local peak and the S&P500 fell about 7% in the next month with many emerging markets falling 20%+. RNE fell more about 40% to a no-premium level. The twig that got the equity markets going on the downside was the threat of higher Japanese interest rates. This caused some hedge funds with yen carry trades to unwind their positons which meant selling the S&P500 and emerging market equities. It also caused them to look closer at high-yielding emerging market currencies and bonds such as Turkey, South Africa, and Iceland. Although these have high yields, thus making them attractive for carry trades, they also have high current account deficits. Investors feared both higher interest rates and a higher yen in which they had short positions.

The Matador fund lost 30.22% in May turning a 2006 gain of 31% to −6% at the end of May. The market was down 3% but Niederhoffer was so leveraged that the loss was magnified ten times to some $100 million. This hedge ratio of 10 means that Niederhoffer must have been massively long S&P500 futures and/or short S&P500 equity and/or futures puts. This is a huge long position that is not risk-control-safe and subject to large losses with a modest drop in the S&P500. A medium S&P500 drop (see below) would likely have led to losses in the 50% area and a large 10%+ drop to losses of 75%+. Niederhoffer said "I had a bad May. I made some mistakes, that's regrettable . . . but one sparrow does not make a spring; and nor does one bad month." June 2006 continued badly with the Matador fund down 12% for 2006. When the May to July debacle in the S&P500 ended it was down about 7% but Matador lost 67% and Manchester 45%. Both funds are still trading and the saga continues (see below). WTZ maintains the two rules: do not over-bet and do diversify in **all** scenarios. One can still make good gains in the S&P500 futures and options and other markets. But somewhat smaller than 30–40% gains are most likely but presumable without blowouts if one has position sizes such that the fund or account will weather a 3–7% decline in 1–4 days or a 10–15% decline over a month.

Ziemba's experience is that proper risk control in the S&P500 market, which is not diversified, can yield net gains in the 15% to perhaps 25% range but 30–40% seems attainable only with substantial risk that likely will cause

Table 22.3. Manchester Partners net returns in various time periods versus the S&P500.

Recent Returns	Latest Month	Last 3 Months	Last 6 Months	Last 12 Months	Last 18 Months	Inception 5-Apr
Partners	20.44%	21.44%	80.26%	8.40%	51.72%	83.72%
*S&P*500	*1.65%*	*4.38%*	*12.66%*	*12.36%*	*17.86%*	*21.82%*

Source: Manchester Trading, LLC (2006).

a large loss if a bad scenario occurs. Of course, other strategies could yield such higher returns as Blair Hull, Jim Simons, Harry McPike, and others have shown.

Niederhoffer was given a third chance after all! Table 22.3 shows the Manchester Partners returns to the end of January 2007.

The May to July blowout is seen in the 8.4% returns in the last 12 months down from 89.9% as of April 2006. But the fund gained 20.44% in January 2007 and the April 5, 2005 to end January 2007 net returns are back to 83.72%, well above the S&P500. So Niederhoffer is back in business once again ... perhaps till the next time.

The Amaranth Advisors Natural Gas Hedge Fund Disaster (2006)

On September 19, 2006 the hedge fund Amaranth Advisors of Greenwich, Connecticut, announced that it had lost $6 billion, about two-thirds of the $9.25 billion fund, in less than two weeks, largely because it was overexposed in the natural gas market. Amaranth's experience shows how a series of trades can undermine the strategy of such a hedge fund and investors' assets. The Greenwich, Connecticut fund which was founded in 2000, employed hundreds in a large investment space with other offices in Toronto, London, and Singapore. We analyse how Amaranth became so overexposed, whether risk control strategies could have prevented the liquidation and how these trends reflect the current state of the financial industry. We have argued that the recipe for hedge fund disaster almost always has three parts:

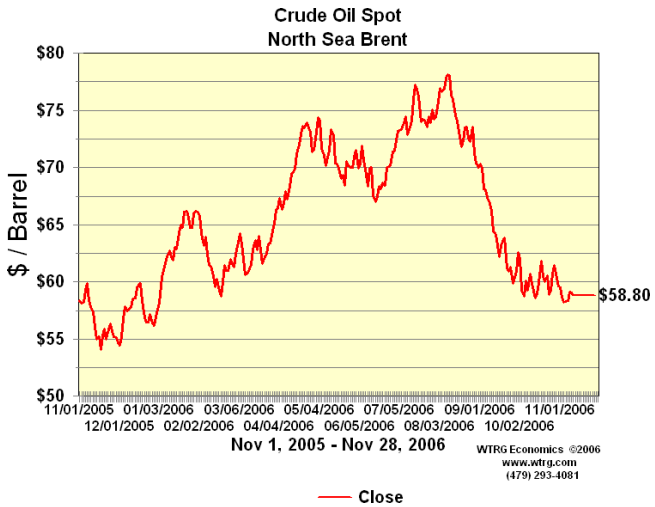
1. A trader over-bets relative to one's capital and the volatility of the trading instruments used.
2. The trader is not diversified in all scenarios that could occur.
3. A negative scenario occurs that is plausible *ex post* and likely *ex ante* although the negative outcome may have never occurred before in the particular markets the fund is trading.

One might expect that these two interrelated risk factors (1) and (2) would be part of the risk control assessment of hedge funds. These risks become more pronounced as the total amount of trading grows, especially when trading in billions. But are risks assessed this way?

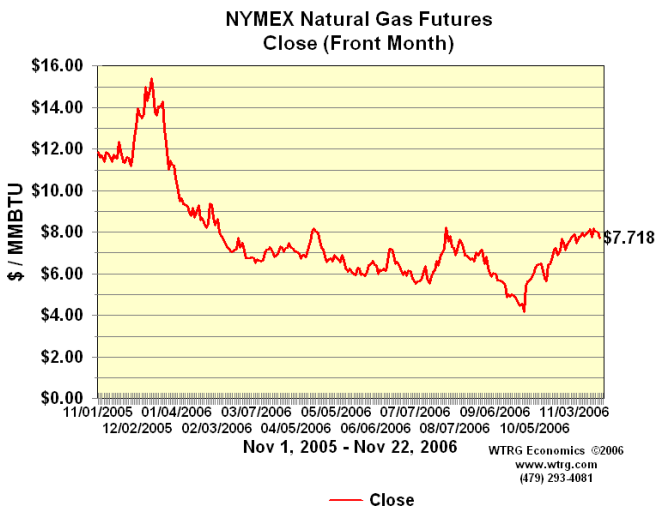
A knowledgeable risk control expert, realizing that the position is not fully diversified and you need scenario-dependent correlation matrices, would simply tell the traders that they cannot hold positions (1) and (2) since in some scenarios they will have large losses. Efficient market types have a lot to learn about real risk control. Hedges are not essentially risk-free. Even a simple model would say that bets should not be made under conditions (1) and (2) because they are far too dangerous. Medium-sized hedge funds are likely reasonably diversified. Some type of risk control process is now standard but these systems are mostly based on the industry standard value at risk (VaR) and that is usually not enough protection in (3) as the penalty for large losses is not great enough.

On occasion, even at a large fund, a rogue trader will have such a successful trading run that careful risk control is no longer applied. Instead, people focus on the returns generated, the utility function of the trader and that of the partners of the fund, rather than the longer-term utility function of the investors in the fund. Rogue trades — those that violate (1) and (2) — can be made as long as (3) never occurs. In the case of Amaranth's natural gas bets, their leverage was about 8:1 so $7 was borrowed for every $1 the fund had from its clients. Positions were on exchanges and over the counter and were thus very vulnerable. Those not skilled in risk control can argue that situation (3) which is great enough to wipe them out, simply would not occur because it is far too improbable, that is too far in the tails of the distribution of the underlying asset. They would typically assign zero to the probability of such rare events.

Even skilled risk control experts such as Jorion (2006) and Till (2006) refer to LTCM as an 8-sigma event and Amaranth as a 9-sigma event. The problem is that even modified VaR gives erroneous results and is not safe. Such wipeouts occur with events far more frequent than 8 or 9 sigma: 3-sigma is more like it. Till (2006) argues that daily volatility of Amaranth's portfolio was 2%, making the September losses 9-sigma, but the possible losses are not stationary. We argue that this analysis is misleading; the 2% is with normal not negative low probability disaster scenarios. Furthermore, diversification can easily fail, if, as is typical, it is based on simply averaging the past data rather than with scenario-dependent correlation matrices. It is the diversification or lack thereof according to the given scenario that is



(a) Crude oil spot: North Sea Brent; November 1, 2005 to November 28, 2006.



(b) NYMEX natural gas futures close, November 1, 2005 to November 22, 2006.

Figure 22.3. Energy prices November 2005 to November 2006.

crucially important, not the average past correlation across the assets in the portfolio.

Figures 22.3(a) and (b) illustrate the nature of the natural gas market. Ziemba and Ziemba (2013, Chapter 32) is a 2012 account of the gas market. Figure 22.3(a) shows crude oil prices from November 1, 2005 to November 28,

2006. This shows much volatility with prices usually above $60 and at times exceeding the August 30, 2005 post-Katrina high of $70+. The oil prices peaked at $77 in July 2006, then declined to around $60 for much of the fall. This decline coincided with the decline in the price of natural gas in September 2006. At that time, widely watched weather-forecasting centers predicted that the hurricane season would not have major storms and that the winter would be mild. Previously on August 29, September natural gas suddenly rose sharply in the last half hour of trading. Why is not known, but manipulation might have been involved. For Brian Hunter, who was short September and long spring months, both events caused massive losses (see the discussion in section on "The trade and the rogue trader").

Figure 22.4 shows natural gas futures prices in 2006. Starting from over $11/million BTU, the futures prices fell to about $5. The event that triggered the Amaranth crisis was the drop in the price of natural gas from $8 in mid-July to around $5 in September. Since gas prices have climbed to $15 and fallen to $2 in recent years, such a drop is plausible in one's scenario set and should have been considered. There are fat tails in these markets. There is a large difference between the daily and long-term moving average price of natural gas, making it a very volatile commodity. Thus such a drop is not a 8–9 sigma event. In the 1990s, natural gas traded for $2–3 per million BTUs. However, by the end of 2000, it reached $10 and then by September 2001 fell back to under $2. Figure 22.3(b) shows the NYMEX natural gas futures prices from November 1, 2005 to November 22, 2006 which like Figure 22.3(a) shows much price volatility. The November 22 price of $7.718 had recovered 50% from the September lows.

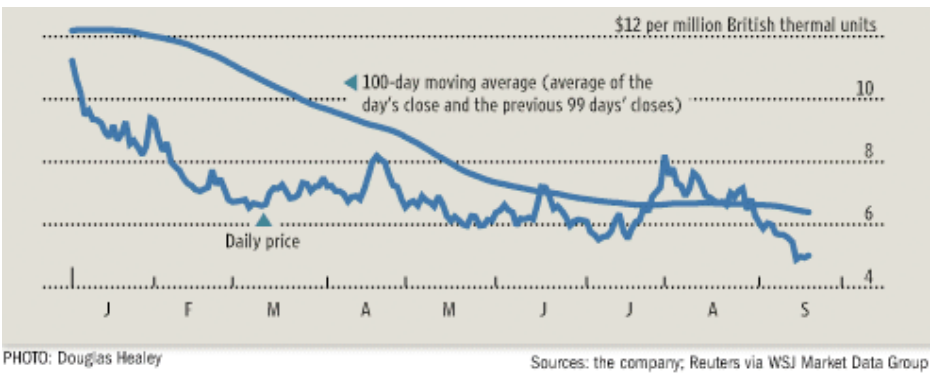


Figure 22.4. Natural gas futures prices in 2006 to September.

Source: *Wall Street Journal*.

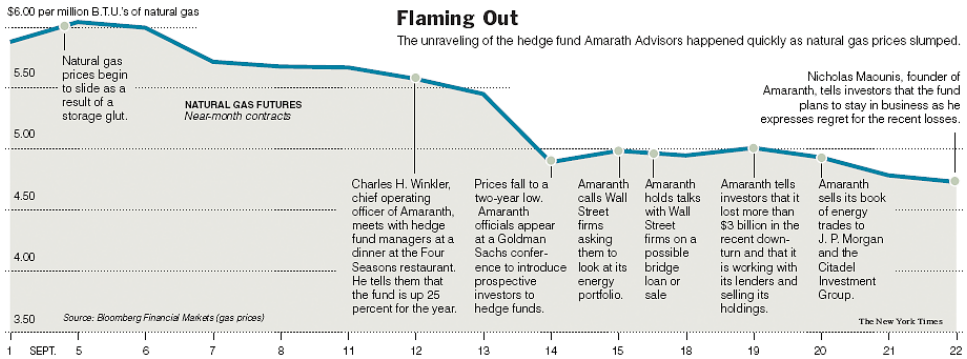


Figure 22.5. Amaranth timeline of a collapse.

Source: *New York Times*, September 23, 2006.

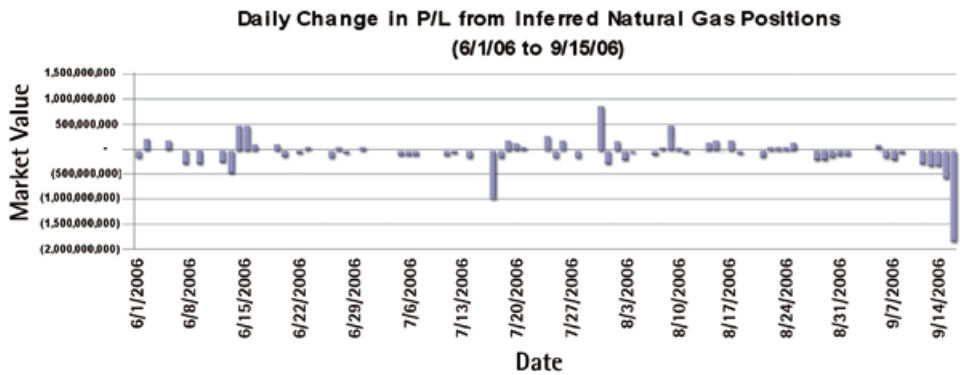


Figure 22.6. Daily change in P/L from Amaranth inferred natural gas positions, June 1 to September 15, 2006.

Source: Till (2006).

Figure 22.5 shows a chronology of the collapse and Figure 22.6 presents a day-by-day recreation of Amaranth's possible losses including the disastrous last two months and final collapse (a loss of $560 million on September 14, 2006) by Till (2006). Davis, Zuckerman and Sender (2007) discuss the bailout saga and some of the winners and losers. They describe how Amaranth scrambled to unload their positions that were losing more and more day by day:

Sept 16 Agreed to pay Merrill Lynch approximately $250 million to take over some positions.

Sept 17 Agreed to pay Goldman $185 million.

Sept 18 Gave up on Goldman deal when clearing agent J.P. Morgan would not release collateral.

Sept 20 Paid J.P. Morgan and Citadel $2.15 billion to take remaining trades after Amaranth absorbed a further $800 million in trading losses.

Valuing a Fund

Actually the statement that Amaranth had $9.25 billion on September 1 is a bit of a stretch because that was the mark-to-the-market value of their portfolio, the value on which fees were charged. But, in fact, with an estimated 250,000+ natural gas contracts (about 30% of the market), an enormous position built up over the previous two years, the liquidating value of the portfolio was lower even before (3), the crisis. As a comparison, in his heyday in the 1990s, a large position for legendary hedge fund trader George Soros of the Quantum Fund was 5000 contracts. Even with one contract you can lose a lot of money: up to $20,000 in a few days. Indeed much of the previous profits were derived by pushing up of long natural gas prices in an illiquid market. WTZ once had 7% of the ValueLine/S&P500 spread futures market. Even at that level, it is very difficult to get out should the market turn on you. With those January effect trades, one has a fairly well defined exit point and the futures cannot deviate too much from the cash spread but even that level is too high and risky.

So the real profits were actually much lower. Those who liquidated Amaranth's positions bought them at a substantial discount. J.P. Morgan Chase, Amaranth's natural gas clearing broker made at least $725 million after taking over most of Amaranth's positions (Davis *et al.*, 2007). Of course, with different data forecasts, such discrepancies might still occur occasionally but if they are consistently there, assumptions or risk assessments may be questioned.

The trigger for the crisis was a substantial drop in natural prices largely because of high levels of stored gas, coupled with a perceived drop in demand due to changing weather, altering the seasonal pattern of trade. The trading theory was based on the dubious assumption that the natural gas market would underprice winter from summer natural gas prices.

Background, adapted from Till (2006)

The natural gas market has two main seasons: high demand in winter and generally lower demand in spring and fall. Storage facilitates provide some smoothing of the price. However, in the United States, there is inadequate

storage capacity for the peak winter demand. Therefore, the winter natural gas contracts trade at ever-increasing premiums to summer and fall months to encourage both storage and creation of more production and storage capacity. Basically the market tries to lock in the value of storage by buying summer and fall natural gas and selling winter natural gas forward.

The prices of summer and fall futures contracts typically trade at a discount to the winter contracts (*contango*) thus providing a return for storing natural gas. An owner of a storage facility can buy summer natural gas and simultaneously sell winter natural gas via the futures markets. This difference is the operator's return for storage.

When the summer futures contract matures, the storage operator can take delivery of the natural gas, and inject it into storage. Later when the winter futures contract matures, the operator can make delivery of the natural gas by drawing it out of storage. Figure 22.7 shows the average build-up of inventories over the year. As long as the operator's financing and physical outlay costs are under the spread locked in through the futures market, this will be profitable. This is a simplified version of how storage operators can choose to monetize their physical assets. Sophisticated storage operators actually value their storage facilities as an option on calendar-spreads. Storage is worth more if the calendar spreads in natural gas are volatile. As a calendar spread trades in steep contango, storage operators can buy the near-month contracts and sell the further-out month contracts, knowing that they can ultimately realize the value of this spread through storage. But a preferable scenario would be for the spread to then tighten, which means that they can trade out of the spread at a profit. Later if the spread trades in wide contango again, they can reinitiate a purchase of the near-month versus far-month natural gas spread. As long as the spread

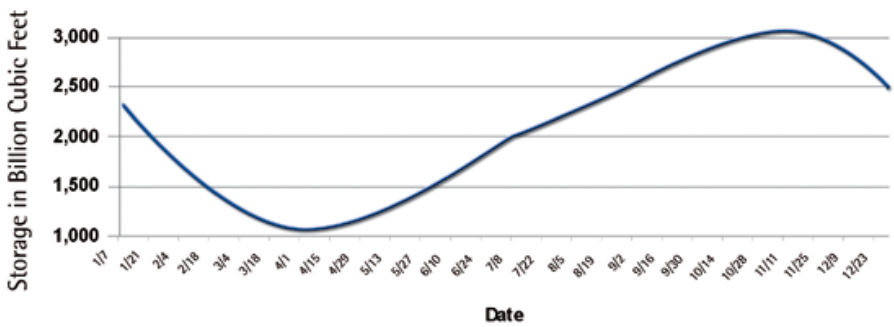


Figure 22.7. Average U.S. natural gas inventories in BCF over the year, 1994–2005.

Source: Till (2006).

is volatile, the operator/trader can continually lock in profits, and if they cannot trade out of the spread at a profit, they can then take physical delivery and realize the value of their storage facility that way. Till (2006) believes that both storage operators and natural gas producers were the ultimate counterparties to Amaranth's spread trading.

In the winter, natural gas demand is inelastic. If cold weather comes early, there is fear that existing storage will not be sufficient, so prices are bid up. The fear of inadequate supplies lasts for the entire heating season. Winter 2005 was an example. At the end of the winter, storage could be completely depleted. For example, during February to March 2003, prices had moved up intraday $5.00/MMBtu, but settled only $2.50 higher, which is why Amaranth hoped for a long winter. As a weak hedge they short the summer (April to October). Demand for injection gas is spread throughout the summer and peak usage for electricity demand occurs in July/August. Being more elastic, this part of the curve does not rise as fast as the winter in a upward moving market. This was their hedge.

The National Weather Service issued an *el niño* forecast for the 2006–2007 winter so gas storage was at an all-time record and the spreads were out very wide. This plus the fact that the market basically knew about Amaranth's positions, led to their downfall, which was a result of their faulty risk control.

The trade and the rogue trader

Let us take a closer look at the trade that destabilized Amaranth. Brian Hunter, a 32-year-old Canadian from Calgary, had fairly simple trades but of enormous size. He had a series of successful returns. As a youth in Alberta, he could not afford ski tickets but at 24, with training as an instant expert on derivatives from courses at the University of Alberta (including one from a colleague), he headed to a trading career. He was bold and innovative with nerves of steel while holding enormous positions. Typically he was net long with long positions in natural gas in the winter months (November to March) and short positions in the summer months (April to October).

Amaranth Advisors was a multi-strategy fund, which is quite fashionable these days since they only have one layer of fees rather than the two layers in a fund of funds. On their website it states: "Amaranth's investment professionals deploy capital in a broad spectrum of alternative investment and trading strategies in a highly disciplined, risk-controlled manner." They provide a false sense of security from the assumed diversification across strategies. The problem is that diversification strategies can be correlated rather than hedged or independent, especially in extreme scenario cases. As a

result, too much can be invested in any one strategy negating diversification. In the case of Amaranth, some 58% of assets were tied up in Hunter's gas trades but risk adjusted, these trades made up 70–90% of Amaranth's capital allocation.

Hunter made huge profits for Amaranth by placing bullish bets on natural gas prices in 2005, the year Hurricane Katrina shocked natural gas refining and production. Hoping to repeat the gains, Amaranth wagered with a 8:1 leverage that the difference between the March and April futures price of natural gas for 2007 and 2008 would widen. Instead it narrowed. The spread between April and March 2007 contracts went from \$2.49 at the end of August 2006 to \$0.58 by the end of September 2006. Historically, the spread in future prices for the March and April contracts have not been easily predictable. The spread is dependent on meteorological and political events whose uncertainty makes the placing of such large bets a precarious matter (Wikipedia, 2006).

Jack Doueck of Stillwater Capital pointed out that while a good hedge fund investor has to pick good funds to invest in, the key to success in this business, is not to choose the best performing managers, but actually to avoid the frauds and blowups. Frauds can take on various forms including a misappropriation of funds, as in the case of Cambridge, run by John Natale out of Red Bank, NJ, or a mis-reporting of returns as in the case of Lipper, Beacon Hill, or the Manhattan Fund. Blowups usually occur when a single person at the hedge fund has the power to become desperate and *bet the ranch* with leverage. With both frauds and blowups, contrary to public opinion (and myth), size does *not* seem to matter: examples include Beacon Hill (\$2 billion), Lipper (\$5 billion), and Amaranth (\$9 billion).

Amaranth's investors will be seeking answers to questions including: to what extent did leverage and concentration play a role in recent out-sized losses? We think the latter; (1) and (2) are the main causes here of the setup before the bad scenario caused the massive losses.

Is learning possible?

Do traders and researchers really learn from their trading errors? Some do but many do not. Or more precisely, do they care? What lessons are taken from the experience? Hunter previously worked for Deutsche Bank. In December 2003, his natural gas trading group was up \$76 million for the year. Then it lost \$51.2 million in a single week leading to Hunter's departure from the Deutsche Bank. Then Hunter blamed "an unprecedented and unforeseeable run-up in gas prices." At least he thought about extreme

scenarios. Later in a lawsuit, he argued that while Deutsche Bank had losses, his group did not.

Later in July 2006, after having billion dollar swings in his portfolio (January to April +$2B, −$1B in May when prices for autumn delivery fell, +$1B in June), he said that "the cycles that play out in the oil market can take several years, whereas in natural gas, cycles are several months." The markets are unpredictable but, most successful traders would lower their bets in such markets. Our experience is that when you start losing, you are better off taking money off the table, not doubling up in the hope of recouping the losses. It is better to lose some resources and be able to survive than to risk being fully wiped out. However, instead they increased the bets.

Amaranth was a favorite of hedge funds of funds, investment pools that buy into various portfolios to try to minimize risk. Funds of funds operated by well known and successful investment firms Morgan Stanley, Credit Suisse, Bank of New York, Deutsche Bank, and Man Investments all had stakes in Amaranth as of June 30, 2006. From September 2000 to November 30, 2005, the compound annual return to investors, net of all costs was a decent, but not impressive, 14.72%. This is net of their 1.5% management fee and 20% of the net new profits. Amaranth had liquidated a significant part of its positions in relatively easy-to-sell securities like convertible bonds, leveraged loans and blank check companies or special-purpose acquisition companies. Liquid investments were sold at a small discount while others, like portfolios of mortgage-backed securities, commanded a steeper discount.

As is common among hedge funds, Amaranth severely restricts the ability of investors to cash in their holdings. For example, investors can withdraw money only on the anniversary of their investments and then, only with 90 day's notice. If they try to withdraw at any point outside that time frame, there is a 2.5% penalty. If investors redeem more than 7.5% of the fund's assets, Amaranth can refuse further withdrawals.

Our experience is that if you lose 50% of a $2 million fund, you will have a hard time relocating to a new fund or raising new money, but if you lose 50% of $2 billion, the job fund prospects are much better. So Hunter moved on to Amaranth whose founder and chief executive, Nick Maounis, said on August 11, 2006, that more than a dozen members of his risk management team served as a check on his star gas trader "what Brian is really, really good at is taking controlled and measured risk." Nick will forever eat these words.

Amaranth said they had careful risk control but they did not really use it. Some 50% of assets in one volatile market is not really very diversified at any

time and is especially vulnerable in a crash and doubly so if one's bets make up a large percent of the market. Such a large position is especially dangerous when the other traders in the market know a fund is overextended in this way and many hedge funds such as Citadel and J.P. Morgan were on the other side of the market. Then, when the crisis occurred, spreads widened, adding to the losses. Hunter's response was to bet more and more (in effect doubling up) until these trades lost so much they had to be liquidated. That is exactly what one should not do based on risk control considerations, but, as discussed below, it makes some sense with traders' utility functions.

Successful traders make a large number of hopefully independent favorable bets which, although they may involve a lot of capital, are not a large percent of the capital nor are they in an illiquid market should one need to liquidate. Warren Buffett's Berkshire Hathaway closed end hedge fund frequently makes $1 billion risky bets but these have a substantial edge (positive expected value) and about 1% or less of Berkshire Hathaway's more than 140 billion capital. The insurance business brings in a constant flow of billions of dollars in premiums. So Berkshire always has a lot of cash to invest. With Buffett keeping billions in cash equivalent reserves for security and good opportunities. A typical Buffett trade was a loan of some $945 million to the Williams pipeline company of Oklahoma at some 34% interest in 2002 during the stock market crash, when the oil price was low and the pipeline company was in deep financial trouble. Banks refused to bail them out. But Buffett knew he had good collateral with the land, pipeline, and buildings. Williams recovered largely due to this investment and better markets and paid off the loan early. Berkshire Hathaway made a large profit. In the 2007–2009 stock market crisis and decline, Buffett made $5–10 billion loans to GE and Goldman Sachs which both were in deep financial trouble. In return he got preferred shares paying a 10% dividend plus free warrant options on the stock of GE and GS. Later, when those were cashed in, Berkshire made billions in profits.

The problem is that rogue traders are grown in particular organizations and are allowed by the industry. While they are winning, they are called great traders, then they become rogue traders when they blow up their funds. The Hunter case is similar to those of Nick Leeson and Victor Niederhoffer but different than Long Term Capital Management (LTCM). In the first three cases, there was a major emphasis on trade in one basic commodity. The trouble was the risk control, namely our (1) and (2) and combined with the bad scenario (3). As discussed in the next sections the firm's and rogue trader's utility function likely caused this problem by making it optimal

for these utility functions to over-bet. LTCM is much more subtle. The confidence scenario that hit them was the result of faulty risk control based on VaR and historical data. They needed scenario-dependent correlation matrices.

Possible Utility Functions of Hedge Fund Traders

One way to rank investors is by the symmetric downside Sharpe ratio (DSSR) (see Gergaud and Ziemba, 2012). By that measure, investors with few and small losses and good sized gains have large DSSRs. Berkshire Hathaway has a DSSR of about 0.917 for the period 1985–2000. The DSSR of both the Harvard and Ford Foundations endowments were about 1.0. Thorp's Princeton Newport's 1969–1988 DSSR is 13.8. Renaissance Medallion, possibly the world's most successful hedge fund, had a DSSR of 26.4 during the period January 1993 to April 2005. See also the other funds in the UMASS hedge fund data studied in Gergaud and Ziemba (2012).

The results come from the choices made using a utility function. Those who want high DSSRs are investors trying to have smooth and good returns with low volatility and very few monthly losses. Thorp only had three monthly losses in 20 years; the Harvard and Ford endowments and Berkshire Hathaway had 2–3–4 per year.

Consider a rogue trader's utility function.[4] The outcome probabilities are:

1. $x\%$ of the time the fund blows up and loses 40%+ of its value at some time; the trader is fired and gets another trading job keeping most past bonuses.
2. $y\%$ of the time the fund has modest returns of 15% or less; then the trader receives a salary but little or no bonus.
3. $z\%$ of the time the fund has large returns of 25% to 100%; then the trader gathers more assets to trade and receives large bonuses.

At all times the rogue trader is in (1) and (2), that is, the total positions are over-bet and not diversified and move markets. There is no plan to exit the strategy since it is assumed that trades can continually be made. Then in a multiperiod or continuous time model, it may well be for the fund managers' and traders' specific utility functions, that it is optimal to take bets that provide enormous gains in some scenarios and huge

[4]An academic treatment of a rogue trader is in Lleo and Ziemba (2014). Here we sketch some ideas.

losses in other scenarios. Kouwenberg and Ziemba (2007) show that in a theoretical continuous time model with incentives, risk taking behavior is greatly moderated if the hedge fund manager's stake in the fund is 30% or more.

In the case of Amaranth and similar rogue trading situations, there are additional complications such as the fund manager's utility function and his wealth stake inside this fund and outside it. Then there is the rogue trader's utility function and his wealth inside and outside the fund. According to Aumann (2005) in his Nobel lecture: a person's behavior is rational if it is in his best interests given his information. Aumann further endorses the late Yale Nobel James Tobin's belief that economics is all about incentives. In the case of Hunter, his share of $1B plus gains (real or booked) was in the $100 million range. What is interesting, and this is similar to LTCM, is that these traders continue and increase bets when so much is already in the bank. Recall in LTCM, that they had a $100 million unsecured loan to invest in their fund. Finally, in such analyses, one must consider the utility functions and constraints of the other investors' money. In the case of Amaranth, Deutsche Bank who had first-hand knowledge of Hunter's previous trading blowups, was an investor along with other well known firms.

This behaviour is symptomatic of doomed hedge fund managers. Sender and Singer (2003) recount the fall of John Koonmen, who founded Eifuku Master Trust hedge fund in Tokyo in late 2000. The fund reached a peak value of $300 million in 2001 before losing virtually all of the asset under management in just over a week. A high tolerance for risk, if not an outright risk-seeking behaviour, leading to large leverage and overconcentration are to blame for the fund's demise: as the fund's capital deeper to $155 millions, Koonmen was still able to invest assets worth $1.4 billion, but decided to allocate them to just a few positions. There were warnings signs, though: Koonmen lost his job at Lehman Brothers after his 1998 trading loss were so large that they had an impact on the bonus of the whole Tokyo equity division. Another sign was the increasing volatility of Koonmen's portfolio in the Amber Arbitrage Fund, Eifuku's predecessor.

Winners and Losers

Who are the winners and losers here? Hunter is a winner and will get relocated soon. He has hundreds of millions, having made about $75 million in 2005 (out of his team's $1.26 billion profit), and will likely make more later. Of course, his reputation is tarnished but $100+ million in fees over

the years helps. Like many others, Hunter had to leave 30% of this in the fund so some of the $75 million was lost. There might be some lawsuits but he likely will not be hurt much. At 32, he is set for life financially, despite the losses. He is likely to begin again. An executive recruiter has offered to help introduce Hunter to investors. He sees opportunities for Hunter to make a fresh start with high-net-worth investors, possibly in Russia and the Middle East.[5] Betting on fallen hedge fund stars is not all that uncommon. John Meriwether, who led Long-Term Capital Management until its 1998 implosion, now runs another hedge fund. Nicholas Maounis, Amaranth's founder and CEO, was exploring starting a new hedge fund. Instead of being ahead 27% for 2005, his fund had to be liquidated. He lost much of his previous fees by leaving much of it in the fund. Since 2005, there were $70 million in management fees and $200 million in incentive fees, his cut was substantial but like LTCM, he should have diversified his wealth.

Other winners were those on the other side of the trade if they followed proper risk control and could weather the storm created by Amaranth's plays, and those like Citadel Investment Group, Merrill Lynch and J.P. Morgan Chase, who took over Amaranth's portfolio and the Fortress Investment group, which helped liquidate assets. J.P. Morgan was named "Energy Derivatives House of the Year, 2006" by *Risk* magazine.

The losers were mainly the investors in Amaranth including various pension funds which sought higher returns to make up for 2000–2003 equity investment mistakes. As of January 30, 2007, they had received about $1.6 billion which is less than 20% of their investment value in August 2006. They will receive a bit more but their losses will exceed 75%. Those who invested in mid-2005 received about 27% of their original investment or about 18% of the peak August value. Other losers are hedge funds like Mother Rock LP which were swept up by the Amaranth debacle including those that lost even though they bet on the right (short) direction because Hunter moved the market long on the way up and those who lost along with Amaranth on the way down. They were long October and short

[5]Indeed in late March 2007 it was widely reported that Hunter was soliciting money for a series of commodity funds with the name Solengo Capital. It is believed that cash-rich investors in the Middle East and Europe are likely to invest. To assuage fears of another meltdown, investors will be able to pick specific managers and commodities. The new fund will impose margin and other restrictions on managers and will eliminate all lock-in restrictions if these controls are violated. The prices of the natural gas contracts Mr Hunter is known to favor had been increasing in anticipation of his return to the market.

September futures. According to Till (2006), they likely were forced out of their short position August 2, 2006 when the spread rallied briefly but sharply. Another loser was Man Alternative Investments Ltd., a fund of hedge funds listed on the London Stock Exchange in 2001 by the Man Group PLC, which shut down after recent losses tied to Amaranth's collapse and persistently poor liquidity in the shares. It is a small fund with little active trading interest, a concentrated shareholder base, and positions that were both difficult to build up and unwind. It had about £31.5 million invested in a portfolio selected by Man Group's Chicago-based Glenwood Capital Investments LLC unit, which is part of Man Group PLC, and has $58 billion in assets under management. The fund lost about one-fifth of its gains during the year from the collapse of Amaranth though it was up 6.5% through October.

Archeus Capital, a hedge fund that in October 2005 had assets of $3 billion, announced on October 31, 2006, that it would close, returning $700 million to their investors. The fund, founded and run by two former Salomon Brothers bond traders, Gary K. Kilberg and Peter G. Hirsch, was like Amaranth, a multistrategy fund. However, it had a more conservative approach that focused on exploiting arbitrage opportunities in convertible bonds. Archeus began experiencing redemptions last year after its main investment strategy fell out of favor. The fund's founders blamed its administrator for failing to maintain accurate records. Their subsequent inability to properly reconcile the fund's records, led to a series of investor withdrawals from which they were not able to recover. Also, Archeus's 2006 performance did little to inspire its clients. Through the first week of October 2006, Archeus's main fund was down 1.9% for the year. However, the fund had returned 18.5% since July 2005. Still, during a period when hedge fund returns have come under increased scrutiny and have, on average, lagged the returns of the major stock market indexes, such a return was insufficient to keep investors on board.

The $7.7 billion San Diego County Employees' Retirement Association has retained the class-action firm Bernstein Litowitz Berger and Grossmann to investigate the Amaranth implosion. Its $175 million investment in Amaranth, which was valued at $234 million in June 2006, is now estimated to be worth only $70 million, thus a $150+ million loss. They should have done better due diligence in advance. Those who bet the ranch on every trade eventually lose it. Investors should have known that was what they were investing in with Amaranth.

Following Amaranth's collapse, investors were seeking someone to blame. Some argued that these bets showed the need for greater or a different sort of regulation of hedge funds, or at least of the sort of over-the-counter trades in the natural gas market. Others including Gretchen Morgenson of the *New York Times*, pointed to the persistence of what many have called the *Enron loophole*, created in 1993, when the Commodity Futures Trading Commission (CFTC) exempted bilateral energy futures transactions from its regulatory authority. This exemption was extended in 2000 in the commodity futures modernization act to include electronic facilities. Many have argued that Enron used such trades to increase the value of long-term contracts. In the run-up of gas prices in 2005/2006, some analysts and politicians pointed to the role of speculators in changing the demand structure, leading a congressional subcommittee to release a report urging that such trades all be the concern of U.S. regulators. Amaranth's collapse brings a different aspect to this debate, as it shows the limits to such self-regulation by market actors. While it is unclear what policy actions might be taken in this matter, this concern is likely to continue and may change the environment in which such trades are made in the future. However, there are limits to the role that can be played by such regulation.

Other small losers are funds of Morgan Stanley and Goldman Sachs who lost 2.5% to 5% from their Amaranth holdings. However as they helped unwind the trades, they may well have recouped their losses when the energy market prices subsequently increased.

There is little impact from this on the world economy. The hedge fund industry now has a bit more pressure to regulate position sizes but most regulators steer away from risk control. When you mention risk control, you are usually encouraged to change the subject. What regulators are interested in is operational risk. The exchanges have limits but rogue traders are able to get around these rules. In any event, if VaR were to be used it would most likely not work unless one is blessed with no bad scenarios. As long as risk control is so poorly understood, misapplied, and disregarded, and pension funds and others are desperate for high returns, such disasters will occur from time to time; and this is fully expected. It is simply part of the hedge fund zero sum gain. For every Jim Simons or Blair Hull eaking out steady profits using a lot of careful research, excellent execution, position sizing, and strict risk control, there is a rogue trader trying to make it by over-betting with very little research and a firm which improperly applies risk control. Improper regulation may well hurt more than help.

Mettallgeselschaft Refining and Marketing Inc (1993)

The story of the Mettallgeselschaft Refining and Marketing (MGRM) disaster is still highly relevant today because it is a complex and passionately debated case. Even 20 years later, several questions remain open:

- Was MGRM's strategy legitimate hedging or speculation?
- Could and should the parent company, Mettallgeselschaft AG, have withstood the liquidity pressure?
- Was the decision to unwind the strategy in early 1994 the right one?

The following discussion expands on description in Lleo (2010).

In December 1991, MGRM, the U.S.-based oil marketing subsidiary of German industrial group Mettallgeselschaft AG, sold forward contracts guaranteeing its customers certain prices for 5 or 10 years. By 1993, the total amount of contracts outstanding was equivalent to 150 million barrels of oil-related products. If oil prices increased, this strategy would have left MGRM vulnerable.

To hedge this risk, MGRM entered into a series of long positions mostly in the very liquid short-term futures (some for just one month). This practice, known as "stack hedging," involves periodically rolling over the contracts as they near maturity to maintain the hedge (see Figure 22.8). Stack hedging helps address the maturity gap between the long-term exposure and the short-term hedging instrument.

In theory, maintaining the hedged positions through the life of the long-term forward contracts eliminates all risk. But intermediate cash flows may not match because of the daily settlement of futures. This could result in liquidity risk.

As long as oil prices kept rising or remained stable, MGRM would be able to roll over its short-term futures without incurring significant cash flow problems. In effect, the rollover of the futures would create positive cash flows that MGRM would be able to invest until the maturate of the forward. However, if oil prices declined, MGRM would have to make large cash infusions in its hedging strategy to finance margin calls and roll over its futures.

In reality, oil prices fell through 1993, resulting in a total loss of $1.3 billion on the short-term futures by the end of the year. All of the losses related to the cash inflow required by the mechanics of the stack hedging.

Mettallgeselschaft AG's supervisory board took decisive actions: they replaced MGRM's senior management and unwound the strategy at an

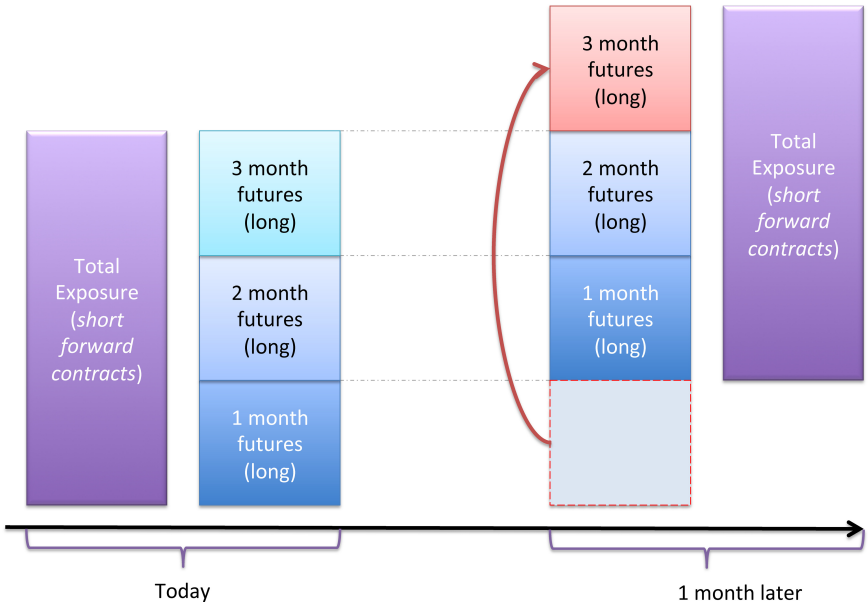


Figure 22.8. Stack hedging.

enormous cost. In the end, Mettallgeselschaft AG was only saved by a $1.9 billion rescue package organized early 1994 by 150 German and international banks.

Mettallgeselschaft Refining and Marketing (MGRM) is one of the best studied financial disasters, mostly because it was the stage of a passionate debate.

Mello and Parsons (1995) analysed the disaster shortly after Mettallgeselschaft's rescue. They generally supported the initial reports in the press that equated the Mettallgeselschaft strategy with speculation and mentioned funding risk as the leading cause of the company's meltdown.

The same year, Culp and Miller (1995a,b) took a very different view, asserting that the real culprit in the debacle was not the funding risk inherent in the strategy, but the lack of understanding of Mettallgeselschaft AG's supervisory board. Culp and Miller further pointed out that the losses incurred were only paper losses that could be compensated for in the long term. By choosing to liquidate the strategy, the supervisory board crystallized the paper losses into actual losses and nearly bankrupted their industrial group.

Edwards and Canter (1995) broadly agreed with Culp and Miller's analysis: the near collapse of Mettallgeselschaft was the result of disagreement between the supervisory board and MGRM senior management on the soundness and appropriateness of the strategy. The key difference between Culp and Miller (1995a,b) and Edwards and Canter (1995) is Culp and Miller's assertion that MGRM's strategy was self-financing, which Edwards and Canter reject.

Société Générale (2008)

A major event in January 2008 was the rogue trader losses at Société Générale. One thing to observe is that in times of uncertainty, there are more rogue traders. Besides this loss, some $1.4 billion was lost on wheat in two days by a rogue trader at MF Global causing them to lose one fourth of their worth.

On January 21 (a U.S. holiday) and 22, 2008 (Monday and Tuesday) nights, the S&P500 futures was some 60 points lower on Globex trading (1265 area) well below previous lows (1406 on August 16, 2007, 1364 on October 17, 2006, and 1273 on March 10, 2008). On both days, the day market recovered, but much damage was done.

Jérome Kerviel and SG lost 4.9 billion euro trading index futures in the DAX, FTSE and CAC. By correlation, the S&P500 fell to new lows. Many were hurt. How could a junior trader hold $50 billion euro in positions?

The sidebar exhibit is Société Générale's explanation of the incident.

What Is a Subprime Loan and Why Have They Caused so much Trouble in so Many Places?

Subprime loans are loans to borrowers who do not qualify for best interest or with terms that make the borrower eventually unqualified as with zero down payment, zero interest.

In general, lending institutions inherently get it wrong. When times are good, they tend to be greedy and try to maximize loan profits but then they are very lax in their evaluation of borrowers' ability to pay current and future mortgage payments.

- Japan in the late 1980s: real estate and stocks, eventually the 10 trillion was lost.

THE GHOST TRADER

Jérome Kervial's job at Société Générale was to take minimal risk; his mission was to balance out positions on his book. But Société Générale says flaws in its control system allowed the trader to leave the bank with a €50 billion exposure.

ROUTINE

On a normal day, Mr. Kerviel would balance a bet that a stock-market index would rise with a contract on a futures exchange or another bet that the index would drop.

FICTITIOUS

For almost a year, Mr. Kerviel allegedly made real bets one way and fictitious bets in the other direction. His supervisors would see a balanced book when, in fact, the bank was exposed to hefty, real risk.

DROPS IN OCEAN

Though Mr. Kerviel's positions exceeded his authorized limit, they were scattered on different balance sheets and drawn within the bank's massive volume of dally operations on futures exchanges.

BALANCING TRAILS

Mr. Kervial allegedly would enter fictitious "forward" contracts, which unlike contracts with futures exchanges, don't necessarily generate money flow until the contracts reach maturity.

ELUSIVE ACTION

Mr. Kerviel allegedly knew the calendar of in-house controls, during which supervisors would scan and recreate new ones immediately after to keep his book balanced out. The temporary misbalance didn't trigger an alert.

Source: Société Générale

- U.S. mortgages: in the run up of real estate, after the internet bubble and Greenspan, interest rates approached 1%. The assumption was that house prices had to rise as they have year by year.

The lending organizations sell off the mortgages and they are cut and diced and bundled into packages like Collateralized Mortgage Obligations (CMOs) and Collateralized Debt Obligations (CDOs) and sold to others who

have trouble figuring out what is in them but look at the rating agency's stamp of approval.

As we have argued, one must be diversified and not over-bet in all scenarios to avoid trouble. But the CMOs, CDOs, and other instruments were extremely leveraged by banks and others.

- The rating agencies with conflicts of interest are also at fault because they failed to point out the potential risks. Many risky derivative products were rated AAA even though they would implode as they did if only one variable, housing prices, declined.
- So it was easy and cheap money.

Recall, the recipe for disaster is

- Over-bet.
- Do not diversify in all scenarios.

Then if you are lucky you can be okay, but if a bad scenario hits, you can be wiped out. Since U.S. mortgages are in the range U.S.$17 trillion, it is an enormous amount of money so a small change makes big impact. The bad scenario in 2005+ in real estate was not a small but a large change, so the total losses could easily exceed 1 trillion as Figure 22.9 shows using data Professor Shiller compiled from 1890 to the peak in 2004–2005. Observe this is 1/10 of Japanese losses in the 1990s. In 2008, it is widely recognized as a crisis. Early warnings of a large real estate decline came from Nouriel Roubini and Robert Shiller in 2006.

Once trouble hits, no one wants to lend, even to good risks. The pendulum has swung to too tight and too high rates. Figure 22.10 shows the interest rates on U.S. treasuries over time from January 2001 to January 2008.

The Fed and other injections were helpful in the first few months of 2008. Japan in the early 1990s was similar: expensive money and you could not get it. Canadian banks get it right more often than U.S. institutions but then the structure is different. Among other things, mortgage interest is not deductible except for that portion of a house that is an office. Also there are fewer exotic mortgages, and higher down payments are required to obtain a mortgage. U.S. foreclosures in 2008 were for mortgages written in 2006 and this continued. Figure 22.11 is a chronology of the subprime saga from June 2007 to January 2008.

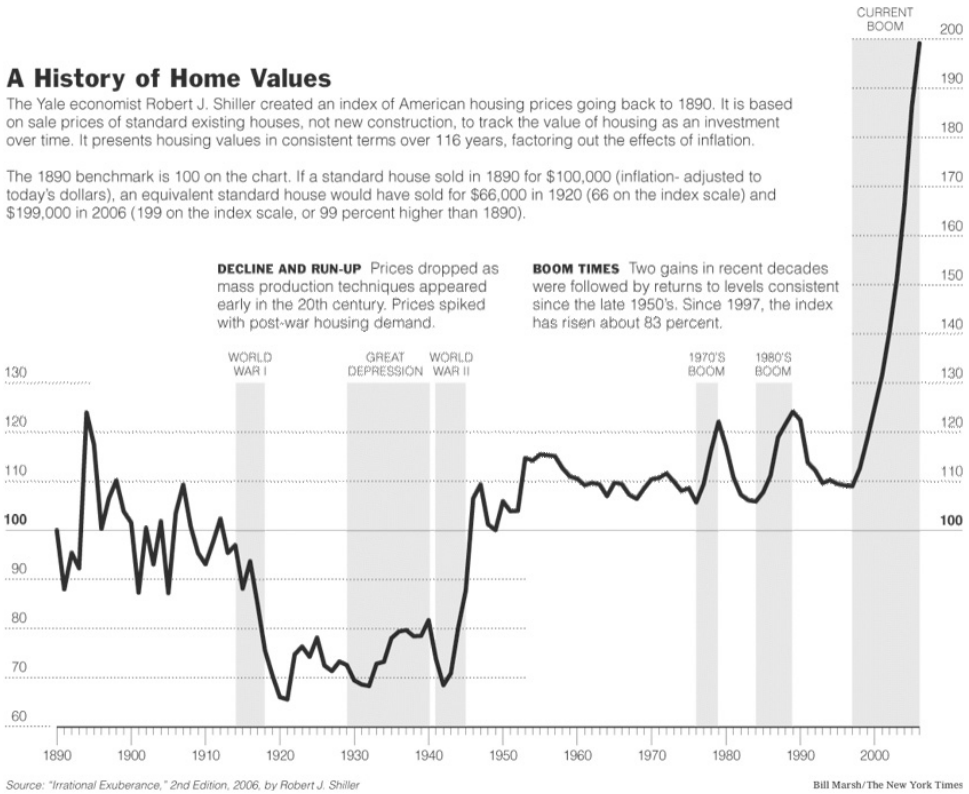


Figure 22.9. A history of home values.

Source: Nouriel Roubini, 2006.

A Brief Chronology of Financial Disasters Since the 1980s

Crises of various kinds for earlier periods of time going back many centuries are discussed in Kindleberger and Aliber (2011) and Reinhart and Rogoff (2009). Harvard Economics Professor Joseph Schumpeter had suggested that recurrent mania is simply a normal feature of business life. Notable blowups include Goldman Sachs Trading Company with late 1928 stock price of $104 rising to $222.50 and down to $1.75 by 1932. Irving Fisher (Yale Economics Professor) in 1929 stated, "stock prices have reached what looks like a permanently high plateau," just prior to the big crash. He lost millions but Yale rescued him.

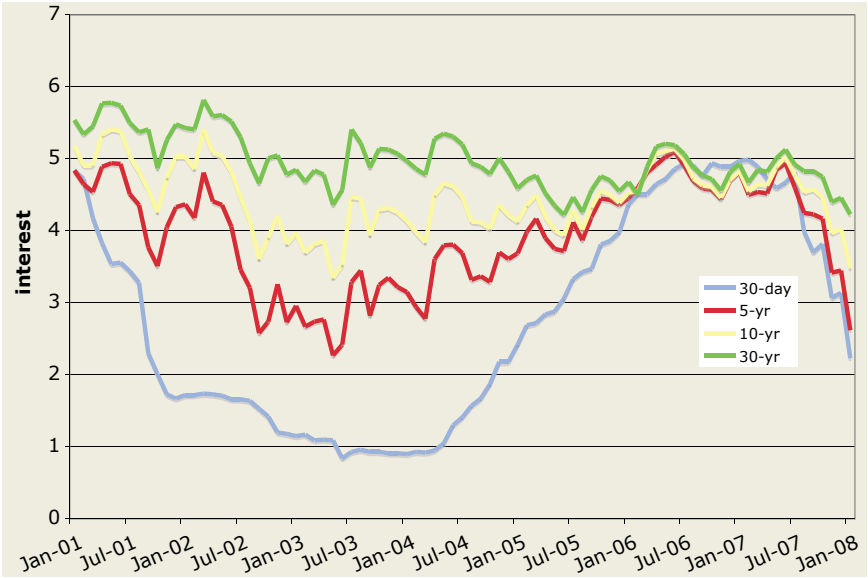


Figure 22.10. Interest on U.S. Treasuries (January 2001 to January 2008).

The trading losses at Société Général are not unique, but they are among the biggest ever disclosed. Here is how they compare with other examples:

BANK/FUND TRADER	**AMOUNT, IN BILLIONS** YEAR	TYPE OF TRADING	OUTCOME
Société Générale Jerome Kerviel	$7.2 2008	European index futures	The bank is seeking a capital infusion.
Sumitomo Corp. Yasuo Hamanaka	S2.6 1996	Copper futures	Hamanaka pleaded guilty to fraud; Sumitomo paid a $150 million fine.
Barings Bank Nicholas Leeson	S1.4 1995	Japanese stock futures	Barings collapsed and was sold to ING; Leeson went to prison for 4 years.
Daiwa Bank Toshihide Iguchi	$1.1 1995	Bond trading	The bank was banned from doing business in the United States; Iguchi pleaded guilty to fraud.
Allied Irish Banks John Rusnak	$0.7 2002	Currency trading	Rusnak pleaded guilty and was sentenced to 7.5 years in prison.

Harvard Economics Professor John Kenneth Galbraith (1994, 2009), an astute observer of economic crises from his research and government service had some general comments regarding these crises:

1. A notoriously short financial memory of twenty years or less creates the conditions for a market collapse.
2. The critic must wait until after the crash for any approval not to say applause.

3. Common features of great speculative episodes include specious association of money and intelligence; money is the measure of capitalist achievement, financial genius is before the fall.
4. Something new: reinvention of the wheel over and over again, often in a slightly more unstable version.
5. Debt is secured by real assets.
6. Leverage is extreme.
7. After the crash, there is anger towards those previously most admired, scrutiny of the previously much praised financial instruments, and the practice of talk of regulation and reform.
8. Not discussed is the speculation itself or the optimization behind it.
9. The reality is all but ignored.

Litzenberger and Modest (2009) mention other trading losses and financial crises, to which we add our discussion. We discuss some of these in detail, and others are just listed. Wikipedia and Yahoo Finance were useful in some of the discussion that follows plus the original sources.

Bad judgment, difficult times, and various levels of secrecy bordering on fraudulence or being fraudulent are also rampant. Examples include Enron (2001), MF Global (2012), a futures and options financial brokerage which offers over-the-counter products, foreign exchange, and spread betting and Monti dei Paschi di Siena (2013), a bank founded in 1472, are recent examples.

We present in this section a chronology of the major financial and trading disasters that took place since the 1980s.

- Hunt Brothers (1979–1980): Herbert and Nelson Hunt, the two sons of oil tycoon H.L. Hunt, took the view that silver would greatly appreciate in price in the high inflation environment of the late 1970s. The two brothers used the futures market to physically buy large quantities of silver. Using their family's assets as collateral, Herbert and Nelson made the most out of the leverage afforded by the futures contracts, building their silver position to $4.5 billion and controlling up to two-thirds of the silver market. Silver price topped $50 per ounce. Eventually, the U.S. commodities regulators introduced futures trading curbs, effectively stopping the Hunt Brother form adding to their position. As demand dried up, silver market stalled and the Hunt brothers faced mounted margin calls. At first, the brothers met their margin calls by borrowing against their family's assets. However, the Federal Reserve intervened, persuading

Phase 1 : Wave of downgrades, the first difficulties for funds and financial institutions

June 2007

- Two Bear Stears managed speculative funds that invested in subprime-asset backed securities are reportedly on the brink of being closed.
- One of the funds is rescued with a $3.2bn loan injection.

July 2007

- Moody's and Standards & Poor's downgrade many mortgage backed securities and put them on the watchlist.
- The value of the two Bear Stearns funds massively invested in subprime mortgages collapses.
- The head of DBS resigns after recent reverses (a hedge fund specialized in subprime assets was closed in May)
- In the US, mortgage lender Countrywide Financial Corp. and the largest US home builder, DR Horton, announce lower profits and a loss in Q2 2007, respectively.
- The German bank 1KB issues a profit warning because of fears over the potential impact of the subprime mortgage crisis.
- American Home Mortgage Investment Corp. announces it is unable to deliver on its loan commitments.

Phase 2 : Things get worse, the first measures, and first support

August 2007

- Detection of additional losses by 1KB leads to a €3.5bn rescue fund set up by its leading shareholder, KfW, and a group of public and private banks. Australia's top investment bank, Macquarie, reports that two of its funds could report heavy losses.
- Oddo closes three of its funds affected by the subprime crisis.
- BNP Paribas freezes three investment funds with real-estate related assets (stating that lack of liquidity makes it impossible to value certain assets fairly).
- American Home Mortgage Investment Corp. files for chapter 11 bankruptcy protection; one of its structures extends the maturity on its asset backed commercial paper.
- BNP Paribas reopens the closed funds.
- The main central banks inject massive funds into the money markets: €94.8bn and then €61 and €48bn by the ECB; $24bn, then $35bn and $2bn by the Fed; and the BoE joins in.
- The Fed cuts its discount rate by 50 bp to 5.75%, announces that it will lend up to 30 days, and injects an additional $6bn.
- The central banks continue their injections.

September 2007

- Bank of England provides urgent financial support for Northern Rock, a bank specialized in mortgage lending; this increases concerns by depositors, who withdraw £3bn over the weekend.
- HSBC closes its US subprime mortgage unit.
- The ECB keeps its key rate on hold, while proceeding to overnight fine-tuning 3-month refinancing operations. The Fed cuts the Fed funds rate by half a point, to 4.75%, and cuts the discount rate by the same amount (to 5.25%).

Phase 3: More-severe stresses, higher loss estimates, resignations, and determined actions by the central banks

October 2007

A flood of poor results in Q3: Deutsche Bank results are affected by the crisis, Merrill Lynch publishes a loss, and its chief executive resigns.

- In the US, a proposed Super Fund set up by banks at the government's request is proposed, at the same time as the "Hope Now" plan based mainly on stopping resets on subprime mortgages originated in the past two years.

November 2007

- More bad news: Merrill Lynch reportedly used speculative funds to conceal losses; Citigroup announces large writedowns ($8bn), and its chief executive also resigns.
- The ECB holds its key rate at 4%; the Fed eases its rules for primary dealers (who can borrow more at its discount window).

December 2007

- Bear Stearns reports its first net loss ever, profits at Morgan Stanley fall by 57% in 2007 and the Chinese sovereign wealth CIC takes a 9.9% stake in the group. Citigroup brings a substantial amount of written down assets onto its balance sheet. After UBS, a Singapore fund invests in Merrill Lynch.
- Early in the month, the major central banks make a coordinated effort to inject $64bn into the market. Given the relative success of the operation, the ECB keeps rates on hold but makes an unlimited liquidity injection to contain pressure on the money market (C348.6bn at 4.21%). Bank of Canada cuts its key rate by 25pb to 4.25% (ending a tightening cycle that began 3 years before); Bank of England does same, bringing its rate to 5.5%; and the Fed cuts by 25pb to 4.25% to counter risks weighing on growth. It conducts two auctions of one-month funds for $20bn each, accepts a broader range of collateral, and longer maturities.
- The proposed SIV Super Fund is abandoned.
- All told, sovereign wealth funds (government bodies, typically vehicles to invest emerging country surpluses) injected $35bn into the global financial sector.

Phase 4 : The central banks offer support, given the risk of contagion to other sectors and the economy as a whole

January 2008

- After UBS, Merrill Lynch and Citigroup, the chief executive at Bear Stearns resigns.
- Slowing growth and worsening credit quality prompt American Express to take an exceptional charge.
- Bank of America, the largest US retail bank, buys Countrywide Financial, the mortgage lender severely affected by the crisis.
- Substantial losses pour Merrill Lynch and Citigroup, of about $10bn each in 4Q2007, when they wrote off $18.1bn and $14.3bn, respectively). While Citigroup manages to report a profit for the year, Merrill Lynch reports a $7.8bn loss.
- Worries regarding monoline insurers. Stock market plunge on January 21.
- The ECB adjusts the amounts of liquidity injected into the market.
- Commencement of an operation allocating $10bn for 28 days to European banks, under a swap agreement with the Fed.
- The first ECB meeting in 2008 leaves rates unchanged.
- The Bush administration announces a fiscal stimulus plan amounting to some $150bn.
- Fed cuts rates by 75bp January 22, between two meetings, to stop equity market panic.

Figure 22.11. Chronology of subprime saga from June 2007 to January 2008.

Source: Crédit Agricole S.A. Department of Economic Research (2008).

banks not to lend money to speculators. Having lost the ability to borrow, the Hunt brothers eventually missed a margin call on March 27, 1980. The silver market collapsed from $48.70 per ounce to a low of $11 per ounce.

- U.S. Savings and Loan Crisis (1970s–1995): U.S. savings and loans (S&L) institutions or "thrifts" originate in the British concept of "building societies". They are regional institutions, whose primary purpose is to originate mortgages. From the 1930s onward, Regulation Q had prevented S&L institutions from merging across states and from holding risk investments. By the late 1970s, S&L institutions were under threat. Money market funds, which were not subject to Regulation Q, were able to take advantage of interest rate volatility to provide higher returns than S&L institutions. S&Ls began to lose their customer base. To keep competitive, S&Ls made the case that they should be allowed to invest in a broader range of assets. Key parts of the regulatory framework were repealed, and S&L institutions began investing in riskier activities, making forays into commercial real estate loans and investing in junk bonds. However, many S&L institutions neither had the expertise nor the manpower required to deal with these new types of risks.

  Up to a third of the 3,234 S&L institutions failed over the period 1986–1995: 296 were closed by the Federal Savings and Loan Insurance Corporation (FSLIC) between 1986 and 1989 and a further 747 were closed by the Resolution Trust Corporation between 1989 and 1995. The General Accounting Office estimated that the total cost of the cleanup reached $160 billion, including $132 billion paid directly by taxpayers.
- Mexican Default and Latin America Debt Crisis (starting 1982): During most of the 1970, Latin America borrowed heavily on international capital markets in a bid to speed up the industrialization of their economy. It is reported that Latin American debt to commercial banks increased at a cumulative annual rate of 20.4% between 1975 and 1982, leading to a quadrupling of external debt in the region from $75 billion to $315 billion over the same period.

  The 1979 oil shock and resulting recession prompted the U.S. and European central banks to increase interest rates. This led to a sharp increase in interest payments and refinancing costs for developing countries. By August 1982, Mexico declared that it would default on its debt. As a result, commercial banks reduced drastically their loans to Latin America, triggering a liquidity crisis in the region. The International Monetary Fund intervened, organizing new loans in exchange for the implementation of strict economic measures.

- Continental Illinois National Bank and Trust Company (1984): Continental was born out of the 1910 merger of two Chicago-based banks: the Commercial National Bank and the Continental National Bank. At the time of its collapse in 1984, Continental was the seventh largest bank by deposit in the United States with $40 bn in assets. A large part of the blame for Continental's insolvency went to the bad loans it had purchased from Penn Square Bank, which specialized in loans for oil and gas producers and service companies and investors in the Oklahoma, after Penn Square's failure in July 1982. Continental's woes were compounded by frauds committed by a number of lending officers led by John Lyte. By May 1984, rumours of an impeding failure had reached large depositors. Withdrawals topped $10 billion (a quarter of all deposits) by early May. Fearing a generalized bank run, Federal Reserve and Federal Deposit Insurance Corporation (FDIC) intervened, injecting $4.5 billion of new capital. Continental, the original "Too Big To Fail", remained the country's largest banking failure until Washington Mutual collapsed in 2008.
- Bank of New York (1985): In November 1985, a computer glitch resulted in a $23.6 billion overdraft at the Bank of New York. The bank required a $24 billion overnight loan from the Federal Reserve Bank of New York, costing $5 billion in interest.
- Black Monday (1987): Work markets plunged on Monday, October 19, 1987. In particular, The Dow Jones Industrial Average fell by 508 points to 1738.74 (a 22.61% drop). The BSEYD model predicted this in April 1987 based on high interest rates relative to stock earnings (see Ziemba, 2003).
- Equity and land Crash in Japan (1990–1991): Land fell a year after the stock market. The BSEYD model predicted this in April 1989 (see Ziemba and Schwartz, 1991; Shirayev, Zhitukhin, and Ziemba, 2013). The latter paper discusses the golf course membership market, a bigger bubble than the stock market plus the land and stock market declines.
- Drexel, Burnham, and Lambert (1990): Drexel, Burnham and Lambert was the largest and most influential institution on the junk bond market. Several of its leading members are convicted in a massive fraud case involving insider trading, stock manipulation, and tax law violations.
- Salomon Brothers Scandal (1991): Between December 1990 and May 1991, Paul Mozer, a trader at Salomon Brothers, submitted illegal bids for U.S. Treasuries with the objective of cornering the market.

- Orange County (1994) interest rate derivative losses: When asset market returns are low, it is often tempting to enter into speculative strategies or untested investment products in a bid to push returns up. Orange County in California did both, with devastating consequences.

  At the beginning of 1994, Robert Citron, Orange County's long-time Treasurer, was managing the Orange County Investment Pool with equity valued at $7.5 billion. To increase the fund's return, Citron decided to use leverage by borrowing an additional $12.5 billion through reverse repos, pushing the debt-to-equity ratio up to 1.67 and the financial leverage to 2.67. The assets under management, then worth $20 billion, were mostly invested in Agency notes with an average maturity of four to five years.

  Citron's leveraged strategy can be viewed as an interest rate spread strategy on the difference between the four-year fixed investment rate and the floating borrowing rate.

  This strategy is akin to an invest floating note, or reverse floater. The underlying bet is that the floating rate will not rise above the investment rate. As long as the borrowing rate remains below the investment rate, the combination of spread and leverage would generate an appreciable return for the investment pool. But if the cost of borrowing rises above the investment rate, the fund would incur a loss that leverage would magnify.

  Unfortunately for Orange County, its borrowing cost rose sharply in 1994 as the U.S. Federal Reserve Board tightened its Federal Funds rate. As a result, the Orange County Investment Pool accumulated losses rapidly. By December 1994, Orange County had lost $1.64 billion. This loss amounts to some 8% of the investment pool's assets and 21% of its equity. On December 6, 1994, the county declared Chapter 9 bankruptcy and began liquidating its portfolio.

  Jorion (1997) points out that Citron benefited from the support of Orange County officials while his strategy was profitable — it earned up to $750 million (a 10% return on equity) at one point. But he lost their support and was promptly replaced after the full scale of the problem became apparent, which subsequently resulted in the decisions to declare bankruptcy and liquidate the portfolio.

  The opinion of Miller and Ross (1997), however, was that Orange County should neither have declared bankruptcy nor have liquidated its portfolio. If the county had held on to the portfolio, Miller and Ross

estimated that Orange County would have erased their losses and possibly even have made some gains in 1995.

- Mexican Tequilla Crisis (1994): Sudden devaluation of the Mexican peso occurred in December 1994 following policies that led to a shortage of foreign reserves. There was a sudden reversal of tight currency controls when a new government took over. Banks over-lent with low interest rates to not necessarily the most qualified investors. Prior to this, there were two decades of increased spending, hyperinflation from 1985 to 1993, high debt, low oil prices for their exports, and large commitments to finance spending by the previous government. Commitments to finance past spending by the previous government. To finance the debt, outgoing President Salinas issued 7% Tesebonas bonds denominated in pesos but indexed to the U.S. dollar. So that was de facto a U.S. dollar peso peg. They ran out of U.S. dollars which were used to keep interest rates low in their foreign reserves to maintain the fixed exchange rate, hence the devaluation and scaring away of foreign investors. When the government tried to roll over the debt, investors were unwilling to buy, hence there was a default. President Bill Clinton, on the advice of Treasury Secretary Robert Rubin, arranged a loan of $50 billion with the IMF, the Bank for International Settlements and the Bank of Canada. In the end, the United States made $500 million on their $20 billion part of this. By 1996, the economy was growing and the crisis was over.
- Barings (1995)—Nicholas "Nick" Leeson scandal: Leeson went to prison in Singapore... and now lectures for about £10,000 per talk.

  Nick Leeson incurred a $1.3 billion loss that bankrupted the 233-year old Barings PLC bank. While based in Singapore, Leeson had accumulated long positions in Japanese Nikkei 225 futures with a notional value totalling $7 billion. As the Nikkei declined, Leeson hid his losses in a "loss account" while increasing his long positions and hoping that a market recovery would return his overall position to profitability.

  But in the first two months of 1995, Japan suffered an earthquake and the Nikkei declined by around 15%. Barings suffered a GBP 860 million loss, twice the bank's capital. Barings went bankrupt and was bought by ING for GBP 1.

  Leeson's control over both the front and back office of the futures section for Barings Singapore was a leading contributor to this disaster because it allowed him to take very large positions and hide his losses. Another main factor was the blurry matrix-based organization charts

adopted by Barings. Roles, responsibilities, and supervision duties were not clearly assigned.

This created a situation in which regional desks were essentially left to their own devices.

- Daiwa Trading Scandal (1995): A New York-based trader for Daiwa Securities Group, Toshihide Igushi, accumulated $1.1 billion of losses during an 11-year time period. As in Leeson's case, Igushi had control over both the front and back offices, which made it easier to conceal his losses.
- Sumitomo (1996) — copper trading losses: London-based copper trader, Yasuo "Mr. Copper" Hamanaka, entered into a series of unauthorized speculative trades in a bid to boost his section's profits. But the trades resulted in the accumulation of approximately $2.6 billion in losses during 13 years.
- Enron (2001) energy trade failures compounded by fraud and corruption (see Douglass, Yu, and Ziemba, 2004) discusses the pension losses of employees.

  Enron's calendar year 2000 Form 10K, filed in early April 2001 displayed important warning signs:

  — Concerns related to cash flow disclosures: a need for heavy financing as investing cash flow exceeds operating cash flow by a wide margin in 1998 & 1999.
  — Enron's management was under pressure to support both the stock price and debt rating: maintaining the investment grade status was critical to the success of its wholesale business and its ability to maintain adequate liquidity.
  — Use of mark-to-market method for other types of contracts (other than permitted by U.S. GAAP for its inventory as commodities) was unusual.
  — Engaged in securitization of assets in its so-called price-risk-management business: report assets sales to SPEs with inflated values, reported a gain on sale of a portion of a JV when the technology for the venture did not exist.
  — Extended its mark-to-market accounting to equity-method investments (the equity method enables companies to keep assets and liabilities off the BS). Under the equity method of accounting, Enron should report its percentage share of GAAP income on its IS, not market-value method.

— The allowance for doubtful accounts grew significantly in the last two years, which calls into question the quality of the receivables and underlying revenues.
— Barter transaction recorded.
— Related party transactions: Enron entered into transactions including receivables, derivatives, sales of assets with limited partnership (the Related Party) whose general partner and managing director is a senior officer of Enron.

This type of self-dealing amounting to billions of dollars is what ultimately led to the collapse of Enron when potential write-down related to these activities were announced in October 2001. There were also ample red flags outside of SEC filings:

— In May 2001, Enron's vice chairman resigned.
— In August 2001, the president resigned.
— The proxy statement shows that top management pay was largely from bonus and stock awards (e.g., the chairman of the board received more than 90% of his compensation from bonus and stock awards).

- Stock market drop following 9/11 (2001): Markets fell 6% limit after the attack on September 11; then the market was closed for a week and the total fall for the week was about 14%; market was already falling and fell more after.
- Allied Irish Bank (2002) trading losses: Currency trader John Rusnak, working for a small subsidiary in Maryland, USA, accumulated losses of $691 million between 1997 and late 2001. He hid the losses by entering fake hedging trades and setting up prime brokerage accounts, which gave him the ability to conduct trades through other banks.
- Subprime, credit liquidity, and quantitative equity crises (2007–2009).
- Bear Stearns (2007): From 2005 to the end of 2007, Bear Sterns pursued an aggressive strategy, relying heavily on leverage to increase its profit,[6] holding large quantities of derivatives,[7] and launching a number of credit-linked "hedge funds." By the end of 2007, Bear Stearns had become the United States' seventh largest securities firm by capital and ranked among the most admired firms in America. By March 2008, Bear Stearns had joined the vastly less prestigious list of failed financial institutions.

[6]By the end of 2007, Bear Stern's leverage ratio reached 35.6 times.
[7]At the end of 2007, Bear Sterns held derivatives with a notional value of roughy $13.40 trillion.

In fact, the first cracks in the building had appeared in the first half of 2007, when rumours spread that two of Bear Stern's "hedge funds," the Bear Stearns High-Grade Structured Credit Fund and the Bear Stearns High-Grade Structured Credit Enhanced Leveraged Fund, faced severe losses. On June 22, 2007, Bear Sterns effectively bailed out the Bear Stearns High-Grade Structured Credit Fund with a $3.2 bln loan, an amount 100 times larger than Bear Stern's initial investment in the fund. Simultaneously, the firm started negotiations with other financial institutions on a series of collateralized loans to the Bear Stearns High-Grade Structured Credit Enhanced Leveraged Fund. By mid-July 2007, Bear Sterns was forced to admit that the two funds had lost almost of their value by betting too heavily on highly illiquid CDOs. Shortly after, investors launched a lawsuit against the two funds and the firm.

The collapse of the two hedge funds also triggered a loss of confidence in Bear Sterns. This made it more difficult for the the firm to finance its highly leveraged balance sheet and ultimately led to its failure. Bear Stearns was acquired by J.P. Morgan Chase on March 16, 2008 in a deal brokered and partly financed by the Federal Reserve Bank of New York.

- Merrill Lynch (2007): Merrill Lynch Wealth Management currently is the wealth management division of the Bank of America. Based in New York City, it has about 15,000 financial advisors, $13.8 billion (2012) in revenue, and $2.2 trillion in client assets, and is the world's largest brokerage firm. Prior to 2009, it was Merrill Lynch and Co, and it was merged into the Bank of America on September 14, 2008. The firm goes back to 1914 when Charles Merrill and Edmond Lynch joined forces. In 1919, Winthrop Smith joined and in 1930 they spun off to E.A. Pierce. In 1941 they merged into Merrill Lynch, Pierce, Fenner and Beane (see Wigmore, 1985). Smith was running the firm since 1940, leading to Merrill Lynch, Pierce, Fenner and Smith in 1958. The firm moved into the government securities market which gave them the leverage to develop money market and government fund products that led to large growth in the 1970s and 1980s (see *Time*, 1964) and Merrill's large brokerage network named the *thundering herd* allowed it to sell securities it underwrote directly. This gave them an edge on other Wall Street firms. *Fortune* magazine called Merrill's Cash Management Account, with its credit cards, check writing, and money market mutual fund, the most important innovation in years (*Fortune*, 1980). Merrill had a hand in the Orange County disaster. They and others were accused of selling risky ill-adviced securities to the Orange

County treasurer, Robert Citron, thus losing the county $1.69 billion and leading to its bankruptcy. The county sued over ten advisors, accountants, and securities companies. They collected $600 million back of which $400 million was from Merrill which settled without admitting liability in June 1998.

The subprime mortgage crisis hit Merrill hard and in November 2007 they wrote down $8 billion in losses and removed E. Stanley O'Neal as its head and replaced him with John Thain. Thain raised $6 billion from selling the commercial finance business to General Electric and shares in Singapore's Temasek holdings. In July 2008, he announced an additional $4.9 billion in losses in Q4. That made the July 2007–July 2008 losses of $19.2 billion. To try to lighten up their over-betting on mortgages, they sold securities and hedge funds to Temasek for $3.4 billion.

In August 2008, Andrew Cuomo, New York Attorney General, threatened to sue Merrill Lynch suggesting that they misrepresented the risk of mortgage-backed securities. They responded by offering to buy back $12 billion at auction. They then cut costs, froze hiring, and charged $30 billion in losses to their UK operations, thus avoiding tax there. They bought back various securities on deposit with the firm from Massachusetts clients under $100 million. According to Miller and Ho (2008), total losses were $51.8 billion. All the trouble started in 2003 when they bought the collateralized debt obligations team from Credit Suisse First Boston. They became the top underwriter in 2004. In 2006, they bought First Franklin Financial, a large subprime lender, to supply mortgages for the CDOs. They were the lead underwriter on 136 CDOs worth $93 billion in 2006–2007. The CDOs were declining in value in late 2007 but Merrill did not dump them but just held most of them, which led to the losses. By mid-2008, they sold one traunch originally worth $30.6 billion for $1.7 billion cash plus a $5.1 billion loan to Lone Star Funds.

The troubles continued and MBIA, a bond insurance company, was sued for fraud and other violations. The essence being the complicated nature of CDOs with exotic hard to price risky features such as CDOs "squared or cubed" that were supposedly "hidden." But the court ruled otherwise and threw out the claim that AAA rated securities were really AAA quality. So MBIA had to pay. This all led to a September 14, 2008 sale to Bank of America for $38.25 billion in stock. The price was a premium to current mark-to-the-market values but well below the September 2008 value. In March 2009, Merrill reported that they received billions from insurance with AIG and $6.8 billion of AIGs

government bailout. There were a number of regulatory actions of various kinds form 2002. Especailly troublesome to us is that out off 36.2% of the TARP money received for their bailout, some $3.6 billion, went to executive bonuses. The bonuses were announced on December 8, 2008 after Bank of America approved the merger but before Q4s financial results were announced. This money went to employees already with salaries of $300,000 plus. Wow! Outrageous actions like this have led to somewhat better approach to executive compensation including performance-related pay, deferred compensation, and roll backs.

- Lehman (2008): Lehman Brothers, a famed bond operation and financial services firm, filed for Chapter 11 bankruptcy protection on September 15, 2008. The filing is still the largest bankruptcy filing in U.S. history with Lehman holding over $600 billion in assets, including large accounts of various hedge funds and other financial institutions. The systemic risk with much interconnections and a refusal of the U.S. government to bail them out was a major factor pushing the stock market much lower. The Dow Jones Average fell 4.4% on September 15 and another 7.0% on September 29. Meanwhile the S&P500 futures fell 9.74% in September, 20.11% in October, 9.22% in November, and 44.2% for the year 2008. Henry Paulson, the then Treasury secretary, said it was not possible to bail them out. Since Paulson was a former CEO of Goldman and a vicious competitor to Lehman, one wonders if politics might have been a factor here.

  The Lehman bankruptcy is yet another example of over-betting, not being diversified and being hit by a bad scenario. They had a huge amount of debt, 31-1 leverage. As they were way over-bet, a 3–4% decline in the value of its assets would and did wipe them out. There were over 100 hedge funds which used Lehman as their prime broker, that is to raise funds and hold positions. These positions of value over $400 billion were frozen. Lehman, like others, got sucked into the subprime mortgage market. They securitized low-rated mortgages of poorly financed homebuyers including some Ninja (no income, no job, no assets) loans to those with no money, no job, no assets. For those only rising real estate would work, but as we know, the real estate market peaked in 2005–2006 and then fell sharply in most areas of the United States. By the second quarter of 2008, Lehman reported losses of $2.8 billion and raised $6 billion in new capital. Their stock fell 73% in Q1 and Q2 of 2008. They initially released 1500 people (6%) just before Q3 reporting period in September.

  There were some possible bailouts. One was the Korean Development Bank whose low offer of $6.40-per share was rejected by Lehman and it

was not clear if the regulators would accept the purchase. On September 9, 2008, Lehman's shares fell 45% to $7.79 when the Korea Bank dropped out. This led to a fall of 3.4% in the S&P500. On September 10, they announced a $3.9 billion loss. The New York Fed, led by Timothy Geithner, considered a bailout with Barclays and Bank of America involved. But the Bank of England and the FSA in London were against this. Bank of America dropped out when Paulson refused to insure part of the losses.

After the bankruptcy, J.P. Morgan, backed by the Fed, put up $87 billion on September 15 and $51 billion on September 16. On September 22 there was a revised proposal to sell the brokerage part including Lehman's midtown Manhattan office building valued at $960 million for $1.29 billion. With Barclays back in the game, with no alternative, the deal went through. Barclays received $43 billion in securities and $45.5 billion in liabilities. Barclays had Lehman's employee liabilities of up to $2.5 billion depending upon how long they stayed with them. Finally, on November 22, 2008, Nomura purchased Lehman's Asian holdings.

There were many institutions and individuals who lost the investments they had held by Lehman. For example, 43,700 people in Hong Kong invested HK$15 billion in guaranteed mini bonds. These were supposedly low-risk. The Hong Kong government partially bailed out these and other derivative positions at their now deflated value so that these investors got a small part of their investment back. And the final straw: Richard Fuld, head of Lehman Brothers, walked away with $480 million and other top executives were given high pay just before the bankruptcy filing.

The Fed minutes dated six weeks after Lehman filed for bankruptcy on September 15, 2008 were released in February 2014. Fed chair Bernanke is recorded saying "What in the heck were you guys doing letting Lehman fail?" The Fed had a meeting on September 16, the day after Lehman failed and did nothing. There was a lot of dissent. For example Christine Lagarde who was France's finance minister at the time, said, "For the equilibrium of the world financial system, this was a genuine error."

Both Bernanke and Paulson have since said they could not save Lehman as "their hands were legally tied" (Eavis, 2014). Harvey Miller, a lawyer representing Lehman, recently noted that in March 2008 the Fed was able to bail out Bear Stearns and helped bail out AIG the day after Lehman filed for bankruptcy so this was a later rationalization. The real reason why Lehman was not bailed out could be that Bernanke and Paulson expected other Wall Street firms to bail them out and they wanted to avoid other taxpayer bailouts. Of course, we come back to the rivalry of Goldman and

Lehman and supposedly Paulson's hatred of Fuld. However, the Fed did try to get a group of Wall Street banks to organize a bailout of Lehman but that failed.

While Lehman collapsed with litigation continuing to this day, Lehman Futures survived during the dark days of September 2008. This is a good case to illustrate that Futures exchanges unlike banks and shadow banks have remained financially stable. Lehman Futures was a shadow bank.

- AIG (2008): The U.S. government made a $85 billion bailout when the American International Group, a multinational insurance company with 63,000 employees in more that 130 countries, failed. The company started in 1919 when American Cornelius Van der Starr established a general insurance agency in Shanghai, China. The business expanded and in 1939 moved the headquarters to New York City. In 1960, Starr hired Maurice R "Hank" Greenberg to develop an international accident and wealth business. Greenberg organized selling insurance through independent brokers rather than agents to avoid their salaries. Then they could price insurance better. AIG was organized in 1967 to include all of Starr's businesses. Then in 1968, Starr made Greenberg the head. They sold credit protection in its London office as credit default swaps on collateralized debt obligations that declined in value. Most were backed by subprime housing loans. The 1970s had many political issues in the Middle East and Southeast Asia. As of April 21, 2013, it had a $57.5 billion market capitalization.

The 1980s led to new special products such as pollution liability and political risk. In the 1990s, they added diversifying investments. In the 2000s, there were a number of legal troubles and finally amid an accounting scandal, Hank Greenberg was ousted and replaced by Martin Sullivan. After Greenberg left, AIG obtained tens of billions of mortgages which were risky and bought mortgage-backed securities. When losses occurred in 2007, they had to pay insurance claims and collateral account losses. AIG purchased the remaining 39% to get full ownership of 21st Century Insurance then merged into them in 2008. On June 15, 2008 Sullivan, resigned amid the losses and stock price decline.

In late 2008, AIG suffered in the financial crisis and its own over-betting on the toxic levered assets including subprime loans. The credit default swaps lost a lot of money. Their credit rating was downgraded so they had to put up more margin money. Then by September 16, 2008, AIG was essentially bankrupt the U.S. Fed bailled them out with the $85 billions so they could continue with 70% of the stock going to the

government. This was the largest bailout of a company in U.S. history. Sjostrom (2009) describes this. See also Greenberg and Cunningham (2013) for the whole story summarized here. But the troubles continued. Huge executive bonuses in 2009 of $165 million to executives and total bonuses of some $1.2 billion led to bad PR. Losses continued. In 2011 and on November 3, 2011 the shares had fallen 49% and had a $1 billion share buy back program. There were more government loans and stock offerings totaling $182.3 billion but eventually AIG paid back $205 billion so they made a profit.

- Citigroup Inc (2008). Known as Citi, the multinational financial services corporation is headquartered in New York City. The company dates from 1812 and in 2012 was the third largest bank in the united states with the largest shareholders including funds from Singapore and the Middle East. They currently have about 16,000 offices in some 140 countries with about 260,000 employees counting the Citicorp and Travelers parts of the business. Before the 2008 financial crisis, they were the largest bank worldwide, a place now held by J.P. Morgan Chase. They had enormous losses in 2008 from subprime mortgages and CDOs and poor risk management, and were bailed out in November 2008 by the U.S. government TARP which later took a 36% equity stake paid with $25 billion of the bailout money along with a $45 billion line of credit (Citigroup, 2008). The government guaranteed losses on more than $300 billion of underwater assets and gave them $20 billion but there were conditions. For example, the CEO had his salary reduced to $1/year and other executives were capped at $500,000 cash plus restricted stock only exercisable when the bailout was paid back. By December 2010, Citi repaid the bailout loans and the government made $12 billion profit from the sale of shares. Citi recovered from the crisis and became one of the best capitalized banks in the world, although along the way in 2012 they failed the Fed's stress test. They, like many others, had their share of legal difficulties over the years such, as having a hand in the 2001 Enron crisis and being fined for taking funds from clients credit cards.
- UBS (2008) subprime losses: At the end of 2007, UBS announced that it would write off $18 billion of failed investments involving the subprime housing market in the United States. In 2008, the write-offs increased to more than $50 billion. In April 2008, at the request of the Swiss Federal Banking Commission, UBS published a report (UBS, 2008) detailing the reasons for its losses. In October 2008, the Swiss central bank announced its intention to take $60 billion of toxic assets off UBS' balance sheet and

to inject $6 billion of equity capital. Shefrin (2009) uses the 2008 as a base to develop a behavioral analysis of the UBS crisis.

- Madoff fraud (2009): Bernie Madoff ran a ponzi scheme where results were made-up to look good. Some observers like Ed Thorp who investigated it in 1991 for a private client knew about the fraud when he could not find the trades (see his column in *Wilmott* magazine). Many lost money, a list was in the *Wall Street Journal*. In 2014, J.P. Morgan Chase had to pay over $2.5 billion for failing to ignoring their information on the fraud.
- UBS (2011) rogue trader: Kweku Adeboli was arrested on September 14, 2011 and later sentenced to seven years in jail in relation with a GBP 2.3 billion trading loss. While working at one of UBS' London offices, Adeboli had set up and hidden speculative on S&P 500, DAX, and EuroStoxx Futures. When in the summer of 2011 these positions began to incur losses, Adeboli increased his bets in the hope of returning to profitability. This decision further fuelled his losses.
- MF Global (2012) had many large fines and penalties for risk supervision failures in 2008 and 2009 during the financial crisis. In March 2008, the stock price fell dramatically due to fears regarding their liquidity among investors, advisors, and analysts. In March 2010, Jon Corzine was named CEO. Corzine was a former Goldman, former governor of New Jersey, and former U.S. senator. His involvement in the troubles to come is uncertain but could have been a force in the $6.3 over-bet on eurobonds. He resigned in November 2011 and was not charged with anything.

  In 2011, they had a liquidity problem and it was thought that they had to use customer money to cover margin on mark-to-market losing positions. The customer money was legally supposed to be in segregated accounts. MF Global took repo agreements off the books. Again, a violation of the rules. Then they made a $6.3 billion bet on European weak country bonds. These led to massive losses as the euro debt crisis worsened. In October 2011, they had a meltdown caused by improper transfers of $891 million from customer accounts to cover trading losses. Then on October 31, 2011, they declared bankruptcy and faced liquidation. Employees were fired without any severance pay or bonuses or deferred compensation. The customer losses as of April 2012 were $1.6 billion. In January 2013, a judge approved a 93% return of customer investments. So most people will get most of their investment funds.
- Monti dei Paschi (2013) largest bank in Siena Italy fails. Banca Monti dei Paschi di Siena founded in 1472 is the oldest surviving bank in the world and Italy's third largest bank with about 3000 branches and 4.5 million

customers. Rising yields and declining valuations on Italian government debt in 2008 during the European sovereign debt crisis led to a loss of $2 billion. They were recapitalized by the government. Then in 2009, the Santorini and Alessandria branches had large losses. To hide them, the top management entered into 500–700 million euro derivative contracts with Deutsche Bank and Nomura. The auditors and Banca d'Italia did not know about these positions. But in November 2012, the new board discovered the situation and informed the Banca. The shareholders and analysts did not know about these derivative losses. On January 22, 23 and 24 the bank's shares fell 5.6%, 8.43% and 8%, respectively. Massari resigned on the 22nd. On January 25, the shareholders gave the board of directors the power to recapitalize, replacing the Tremonti bonds with new Monti bonds and they did receive a 4.1 billion euro government bailout. So they continue but are scarred. The headquarters is in the main plaza where the Palio is run. They sponsored that plus other historic building renovations and other cultural activities which they can no longer support.

Final Remarks

There seems to be no end to a long string of hedge fund and bank trading disasters. The reasons are basically always the same: over-betting, lack of diversification, and vulnerability to a bad scenario. The lack of severe penalties for losses and the incentives associated with possible massive fees leads to this behavior. Here we have discussed hedge fund type, behavior in hedge fund, and other financial institutions such as bank trading departments. We only briefly discuss other types of financial crises. For more on these over many centuries, see Kindleberger and Aliber (2011) and Reinhart and Rogoff (2009). See also Roubini (2011) regarding the European debt crisis of 2011–2014.

Countries fearing contagion when banks and other large investment vehicles fail, continue to bail them out. There have been suggestions that they be recapitalized and follow better risk control but they resist regulation. Sometimes, these bailouts even make a profit for the government even though excessive bonuses to executives should have been avoided. The big hedge funds seem to be able to raise new money after big losses. Hence, more blowouts will occur.

There was much debate concerning the true necessity and value of the U.S. 2008 bailouts, irrespective of whether or not in total they made a profit. It is hard to estimate the higher economic value that would have accrued if

the institutions that were bailed out would have been required to readjust the mortgages. The 56% drop in the S&P500 from the 2007 peak to the March 2009 bottom indicates that action was needed, however, actions like Merrill Lynch giving 1/3 of their TARP money to executive compensation was unwise, and a backlash since then will prevent this next time.

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