

## “Perfect Storms” – Beautiful & True Lies In Risk Management

### Truth or Dare!

Modern life embodies a conflict between “truth” and “aesthetics”. John Kenneth Galbraith, the late American economist, summed this up well. *“A toothbrush does little but clean teeth. Alcohol is important mostly for making people more or less drunk. An automobile can take one reliably to a destination and back, ... its further features are of small consequences ... There being so little to be said, much must be invented. Social distinction must be associated with a house... sexual fulfillment with a particular ... automobile, social acceptance with ...a mouthwash ...etc We live surrounded by a systematic appeal to a dream world which all mature, scientific reality would reject. We, quite literally, advertise our commitment to immaturity, mendacity and profound gullibility. It is the hallmark of our culture.”*<sup>1</sup>

Finance and economics are not immune to this conflict between “truth” and “aesthetics”. “Risk Management” is a beautiful lie. Beautiful lies are lies that we know are not true but desperately want to believe in. Risk Management is also a true lie – something that is inherently false but strangely contains a kernel of truth. I am going to talk to you about the beautiful and true lies of risk management.

### The Great Risk Hunt

“Risk” is a four-letter word. It is polite in company to use the phrase – “risk management”. “Derivatives” is an eleven letter, four-letter word. The sanitised – “derivatives risk management” – is better. All losses are “unexpected” arising from “the unknown” and some sort of “failure”. Of course, it would be far easier to deal with known, expected losses arising from success. Risk, it seems, is the ultimate unknown.

Traders, banks, investors and corporations take risks to make money. Risk management is about measuring and controlling risk. Wouldn't it be simpler to stop trading? Even if you want to manage risk, derivatives just re-arrange risk. Risk management instruments also bring their own risks. Everybody abhors risk taking. They prefer “sure thing taking”. Risk management is all about protection against the perfect storm, the one in ten thousand year flood.

Tanya Styblo Beder, a celebrity derivatives and risk professional, once observed that financial markets represent “the Great Risk Hunt”<sup>2</sup>. This is a party game that many can play. There is the hunt where traders, corporations and investors comb markets in search of that elusive treasure, the next lucrative profit opportunity. Then there is the hunt for risk, where risk managers identify and measure the risks of trading, trying to profit from the opportunity along the way. Finally, there is the hunt for knowledge. This particular quest usually follows some unexpected and (inevitably) large loss, as analysts examine the entrails to understand “what happened”.

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<sup>1</sup> See Economics and the Quality of Life in John Kenneth Galbraith “The Essential Galbraith” (2001, Houghton Mifflin Company) at 103,104

<sup>2</sup> See Tanya Styblo Beder “The Great Risk Hunt” (May 1999) The Journal of Portfolio Management at 29

## Shock Therapy

I learned about risk management early in my banking career. My job was to assist Ron, the secretary of the Asset-Liability Management Committee (Alco), a primitive form of risk management. Alco was responsible for ensuring the bank's risk was carefully managed. This was difficult. Alco liked to take bets on interest rates going up or down in the hope of profit. Informally, the Alco was known as "Punt-Co", reflecting its real activities.

My role was modest. I, the new graduate, assisted Ron with the preparation of the interest rate risk report. This involved "shocking" (moving) interest rates up and down by 5%. If rates were 10%, I would move them to 10.50% and 9.50%. Then, I worked out what impact the changes had on the bank's earnings (net interest rate margin was the phrase). In pre-spreadsheet days, I used accounting information and a hand held calculator to re-calculate the bank's earnings. A simple mistake required re-calculation of the whole thing. The process took weeks. Alco knew the bank's risk about 6 weeks too late.

One day, I asked Ron why we used 5% shocks. He looked at me surprised. After a minute's silence, he said solemnly: "I will have to think about that." I had obviously asked a difficult question. Some days later, he came up to me as I sat crunching numbers for the interest rate report. "I have thought about your question," he began. "If we did a lower number, say 2%, then nobody would believe the risk number. If we did a higher number, say 10%, then the risk would be very high. It would just scare everybody, unnecessarily. 5% is just right. It gives the amount of risk that everybody expects to see." Clearly, it is important to administer the right level of "shock". It can't be too shocking

## The Origins of Risk Management

In the early 1990s, the G-30, a lobby group, produced a report - *Derivatives: Practices and Principles*. The recommended principles recited motherhood, apple pie sentiments.

Directors of the banks should take responsibility for ensuring that risks were managed. The authors were clearly unfamiliar with corporate practice. This was evident in the use of the words - "directors", "responsibility", "accountability" - at the same time. Directors and senior managers should have experience and understanding of risk and derivatives. Most professionals agree that they should at least be able to spell the two words.

Risk management is really risk quantification. Risk managers produce numbers which tell people who don't really want to know what they could lose if what they don't believe can happen does happen. Nobody thinks they will be at sea in the perfect storm. Nobody believes that they will in the low lands when the one in 10,000 year flood happens.

Risk management is a game where form has long replaced substance. It shares this characteristic with most forms of corporate governance. Risk management is like any religious text. Nobody is willing to criticise it in public but few follow it completely in private.

## Risk Paradigms

The risk management industry is big on conferences. Risk consultants and technology firms sponsor the events. I recently attended one after a gap of almost 10 years. The session was entitled something like: *Risk Management: The New Paradigm*. As a general rule, it is unwise to read or attend anything with the word “paradigm” in its title.

The speaker strode onto the stage and secreted himself behind the lectern. It was the DEFCON scale of risk. In US military jargon, DEFCON refers to DEFense CONdition. What DEFCON had to do with risk was not clear. Nevertheless, we lurched from DEFCON 5 to 1 and back again. My DEFCON Risk scale would be something like the following:

DEFCON 5	Go to lunch. The noon bells have tolled “all is well”.
DEFCON 4	Business as usual. Normal indolence and lack of care continues.
DEFCON 3	The smell test tells you that there is a problem. You ask a few questions being careful not to be told anything that you might regret in hindsight when seeking to avoid culpability.
DEFCON 2	You learn that your traders have lost an unspecified amount of money from the various journalists who ring you for comment. You thank them for letting you know what is really going on.
DEFCON 1	The bank is bankrupt. You’re fired. You join the speaker circuit sharing your experiences with other risk luminaries such as Nick Lesson.

There was the “quick/slow”, “smart/dumb” scale. I got the impression that speaker was a “quick smart”. Risk “savages” appeared. In keeping with the defense theme, there were “body counts”. To lend a more scientific perspective, the speaker threw in some technical jargon – “risk regimes”, “the colonisation of uncertainty” and “risk management as anesthesia”. References to an odd collection of famous names – Mark Twain, Yogi Berra, Monty Python – abounded.

The speaker confessed that his daily life was “technical”. It was “absurdly mathematical” and “full of differential equations”. He confided to his audience that on weekends he was likely to read a book on “prime numbers” or a “novel”. Balzac, Jane Austen and Italo Calvino were mentioned. The speaker noted that he frequently mis-read novels looking for its risk structure and patterns of chance in the story. The audience was impressed by speaker’s wide and varied erudition.

Risk management theorists seems to suggest that risk management is just common sense. One should rely mainly on proverbs – “don’t put all your eggs in the same basket”; “pride comes before a fall”; “hedging your bets”; “bad things always come in threes”. In practice, it seems, common sense isn’t that common at all, especially among risk managers.

## The Holy Liturgy of Risk

The most pernicious thing about modern risk management is the illusion of precision. Fischer Black, one of the creators of the ubiquitous Black-Scholes-Merton model, did not like false degrees of precision. Too many decimal points were misleading when the information was inexact. Risk managers and modelers largely ignore this. Spreadsheets with floating 16 decimal points provide false comfort in the perfect storm. Risk models are flawed. Risk is itself a risky business.

Risk management abounds in myths. There is the 4:15 Report. The title refers to the time in New York at which the Chairman of JP Morgan received a daily report summarising the bank's risk. The idea was that the entire bank's risk was reduced to this simple number. The popular mythology was that you pressed a button and out popped the report.

The reality was probably less glamorous. Someone in risk painstakingly pulled data from a myriad of systems of varying degrees of accuracy and reliability and collated them on a spreadsheet. Were the numbers actually correct? Were all the positions that the bank held correctly included? What did the number actually mean? What was it used for? The answers to these questions are inevitably vague. Like religious matters, the experience is the thing. Faith is key. The reader of the Report has no way of verifying whether it was correct. You have to believe in the thing.

The holy liturgy of risk is built around a concept known as VAR - "value at risk". There is also DEAR. It is not a term of endearment but stands for "daily earning at risk".

Barry Schacter (who runs a well known website devoted to risk management [www.gloriamundi.com](http://www.gloriamundi.com)) offers an interesting definition of VAR: *"a number invented by purveyors of panaceas for pecuniary peril intended to mislead senior management and regulators into false confidence that market risk is adequately understood and controlled."*

The concepts all go back to Carl Frederich Gauss, a 19<sup>th</sup> century German mathematician of rare genius. The Gaussian distribution lies at the center of modern finance, especially risk management and financial modeling. It is commonly and mistakenly referred to as a "normal" distribution. There is nothing "normal" about it. Gauss discovered the fact that most natural phenomenon, like the heights of children, fall into a normal distribution.

The key characteristics of the normal distribution is that all points can be described by two numbers – the mean (the average) and variance or standard deviation (a measure of the difference of individual observations from the average measuring dispersion). Modern finance is fixated on these two numbers, especially variance. Variance or standard deviation is synonymous with risk. It measures the size and speed of price changes. The larger the changes in price the higher the risk.

The daily price change is scaled to an annual volatility by multiplying the daily price changes by the square root of time; that is, 1% per day translates into an annual volatility of 15.81% (1% times  $\sqrt{250}$  days in the year). In the world of precise high finance the business year is always assumed to be roughly 250 days (52 weeks by 5 days minus say 10 public holidays). This is the root mean square rule, a common statistical trick, based on Geometric Brownian motion (GBM).

GBM describes how something like the stock price moves randomly over time from its current price in such a way that the daily price changes are distributed normally. The average price change is proportional to the square root of the elapsed time. GBM derives from the work of a botanist – Robert Brown. Brown wrote a paper entitled "A Brief Account of Microscopical Observations Made in the Months of June, July and August 1827, on the Particles Contained in the Pollen of Plants". This brief paper with a long title recorded observations of pollen grains in water buffeted by water molecules. While individual grains moved one way and another, the distribution of the changes in direction was normal. Risk management is founded on the mathematics of children's heights and pollen grains in water.

Gauss' idol was Newton. Gauss disliked the story of the apple falling on Newton's head as the catalyst for the great Englishman's work on gravity. Gauss held that Newton had conjured up the story to deal with stupid, officious bores. The rustic story satisfied these inquisitive people who went away happy and enlightened. Modern risk management is very much like that. A number is produced for an audience that unquestioningly accepts it at face value and are content. What is often forgotten is that Gauss originally intended the normal distribution as a test of error not accuracy.

A risk manager at a bank was hauled up before the Board of Directors. He was called upon to explain why the bank had lost over \$250 million in a single day when its VAR was only \$75 million. "The model must be wrong," complained one of the Directors. "No, definitely not!" The risk manager countered. "Our risk models are run at 99% confidence level. The fact that we lost more on this one day actually proves that our risk models are working perfectly as intended. We should lose more than our measured risk one day in every 100. In fact, the trading loss has only exceeded the risk measure once in several years. This means our risk models are clearly far too conservative." Galbraith once noted that: "Between human beings there is a type of intercourse which proceeds not from knowledge, or even lack of knowledge, but from failure to know what isn't known." This is especially true of much of the discourse on risk.

### Stress and Other Advances

Every religion has dissidents and schisms. VAR has its detractors. The major criticism is that a VAR limit of \$10 million at 99% confidence level is, well, meaningless. It can be satisfied by a portfolio where there is a 99% chance that the losses will be below \$10 million but a 1% chance that the loss is \$1,000 million!

Unbelievers have proposed alternatives to VAR models - stress testing. Stress testing analyses the effect of extreme price movements. It tests the capacity of the bank to withstand the impact of plausible but unusual market conditions, the ability to stand up to the perfect storm or biblical flood – the one in 10,000 year event.

It is common to see what would happens if the past repeated itself. These are some of the more noteworthy events that I can remember.

Year	Event	Details
1987	Stock market crash	Dow Jones equity index falls 31% over 1 week with similar falls in other major global equity markets.
1990	Junk bond crisis	Bankruptcy of Drexel Burnham Lambert and collapse of junk bond market. Collapse of US S&L institutions.
1991	"First" Gulf War	Oil price characterised by extreme volatility.
1994	US interest rates	US interest rates rise rapidly, triggering massive losses in highly leveraged derivative positions held by investors.
1994	Mexican crisis	Mexican market collapses, triggering a significant emerging market liquidity crisis.
1997	Asian crisis	Collapse of Asian equity and currency markets. These events trigger the collapse of a number of corporations and falls in asset prices that create a major bad debt crisis within financial institutions.
1998	Russian default	Russia defaults on its debt, triggering an emerging market collapse.

1998	LTCM collapse	LTCM collapses and has to be bailed out by a group of banks under US Federal Reserve auspices. Market and trading liquidity deteriorates rapidly and credit spreads increase rapidly.
1999	Gold market	The gold market experiences unparalleled volatility as the gold price increases rapidly after central banks announce a reduction in planned gold sales and gold lending programs. This creates large losses for gold hedgers with large forward sales programs.
2000	TMT stocks	The TMT market experiences unprecedented volatility. NASDAQ falls by almost 50% over a short period as investors exit TMT stocks.
2001	Argentina	Argentina defaults on its debt setting off a crisis in emerging markets.
2001	World Trade Center Attack	Attacks on the World Trade Center disrupt trading and trigger a flight to quality in financial markets.
2001/ 2002	US corporate bond crises	Bankruptcy of Enron, WorldCom and other large issuers in the US domestic market amid concerns about errors/fraud in accounting practices.
2003/ 2004	“Next” Gulf War	US led coalition attacks Iraq. Oil prices rise to record levels.
2005	Corporate Credit	After a period of unprecedented decline in credit risk margins, General Motors and Ford are downgraded to “junk” status triggering a sell-off in credit markets inflicting large losses on hedge funds.
2006	Emerging Market Correction	Sell-off in selected equities in emerging markets (such as India and Turkey).
2007	Sub-prime Mortgage Losses	American investors discover that ‘zero loss’ assumptions in sub-prime mortgages are a little aggressive.

The curious thing is that these are all one in 10,000 year events. They seem to occur annually.

A recent cult is extreme value theory (EVT) which has now morphed into ETL (expected tail loss). EVT is based on physical sciences, such as hydrology. Engineers try to ensure that dams or buildings can withstand rare but not impossible natural events, floods and earthquakes. Risk managers seem to have taken the one in 10,000 year flood analogy literally.

Stress testing and EVT are useful. But they come with an entirely different set of problems. They are not easy to integrate – we are forced to use different stress scenarios for different businesses. Also we use scenarios from the past. This assumes that the future is just a repetition of the past. Stress scenarios for the new instruments – the “innovations” beloved of trading and sales desks – are difficult to find. Traders may actually remember what happened in the past and adjust their behaviour. In essence, the crash of the future may be different from the crash of the past.

The biggest problem with stress testing is that nobody takes it seriously. They all think that it won't happen to them. In the end, risk management can only deal with the known unknowns. Unfortunately, it's the unknown unknowns that really matter.

In 1998, Allen Wheat, then at CSFB, gave an after-dinner speech at a conference. He confessed that he “used to sleep easy at night with [his] VAR model”. CSFB had just incurred large trading losses in Asia, Russia, LTCM and just about everywhere else. In all, CSFB had lost about \$1,300 million. Wheat, it seemed, had lost faith in VAR. The conference was at Monte Carlo. There were many people that year whose faith in the liturgy of VAR and risk models was tested.

Peter Bernstein in his book *“Against The Gods: The Remarkable Story of Risk”* argues that the human race’s mastery of risk is its defining achievement. In the end, the allure of certainty is misleading. Nassim Taleb, a canny and battle scarred trader, offers a different perspective. He argues that you should never venture into markets that you don’t understand. The loss you suffer in the future will rarely resemble the ones that you experienced in the past. Markets take the path that will hurt the largest number of players and inflict the largest losses.

### **In the Long Run...**

In late 1998, Long Term Capital Management (“LTCM”) encountered financial difficulties that required a bail-out by banks, orchestrated by the Federal Bank of New York. LTCM is now history. The lessons were forgotten surprisingly quickly. In August/ September 2006, Amaranth, a multi-strategy hedge funds lost \$6 billion after massive natural gas trades went awry. The problems at Amaranth bear a scary resemblance to the events that brought LTCM undone. A brief history of the LTCM saga is highly instructive for risk managers.

Keynes noted that in the long run we are all dead. LTCM showed that the proposition also held in the short run. In fact, they demonstrated that it is possible to self destruct in a surprisingly short time. LTCM is a story of the confluence of many divergent trends - quantitative finance, risk modeling and derivatives trading. Naturally, it is also about the staples of financial markets – fear and greed.

LTCM was a hedge fund formed in 1994 by a group of ex-Salomon Brothers traders led by John Meriwether. It came to be known as Salomon North, reflecting its base in Greenwich, Connecticut, USA. The key principals (in addition to Meriwether) included Eric Rosenfield, Lawrence Hilibrand, William Krasker, Victor Haghani, Greg Hawkins and David Modest. LTCM principals included Nobel price winners Robert Merton and Myron Scholes and former regulators including former Federal Reserve Board Vice Chairman David Mullins.

The core Group had worked together in Salomon Brother’s fixed income arbitrage operations. The individuals did not fit the mould of traditional rough and tumble traders. Most were highly qualified, holding Ph.Ds in economics, finance, mathematics, science or related disciplines. The unifying element was the enigmatic Meriwether. He had hired many of the key players. A graduate of the University of Chicago, Meriwether was one of the earliest to embrace quantitative finance and to realise its potential to unlock trading riches.

He attracted fierce loyalty amongst employees, backing them unquestioningly. There is a story about Meriwether that encapsulates his relationship with his hires. A trader asked Meriwether’s view of a trade that he was considering. “My trade was when I hired you,” Meriwether is reported to have responded. The fact that he paid them extraordinarily well even by the extravagant standards of financial markets also helped in the bonding.

The fixed income arbitrage group's mythology was built around a famous incident. In the aftermath of the stock market crash in 1987, traders at Salomons gathered to discuss strategies. Real world disasters generally create volatility. Traders see them as trading opportunities. Calamities do not result in considered focus on the human tragedy. Disasters cause reflection on which stocks will go up or down and what the currency and interest rate markets reaction is likely to be. Traders often also make side bets amongst themselves when such events occur. After, the 2004 tsunami in Asia, the traders at one bank ran a book on the final casualty number from the disaster.

In 1987, at Salomons, there was a difference of opinion. The traditionalists, John Gutenfreund (Head of Salomons) and Craig Coats (Head of Government bond trading), thought that interest rates would fall. This is what had generally happened in the past. They bought a truck load of 30 year bonds hoping to profit from rising prices as interest rates fell.

Meriwether's boys – the arbitrage group – did not share the consensus view. They noticed that the market disruption had resulted in a lower risk trading opportunity. The 30 year bond consists of 60 interest payment (semi-annual interest coupons) and a final principal payment (the corpus). They could buy the coupons and corpus separately at a lower price than the 30 year bond itself. They did precisely this, buying the components separately, and selling the 30 year bond short, to lock in a profit.

The arbitrage group's trade made money. Gutenfreund's trade – which quickly gained the sobriquet "the Whale" – lost a similar sum. The trades themselves marked a boundary. The purchase of the bonds represented the old – traditional trading. The arbitrage group's quantitative and research driven trade represented the new world of trading. In time the arbitrage group's profits came to represent the bulk of Salomon's profitability. Meriwether's power and influence reached extraordinary heights. Despite deep resentment from other employees, Meriwether and his team were given a lucrative profit sharing arrangement. It was supposedly secret. Few things remain a secret in trading rooms and financial markets for long.

### **Modus Operandi**

LTCM was established with capital of \$4,000 million. The capital came from banks, institutional investors and some private investors. The principals, wealthy in their own right, invested significantly in LTCM. In some case, they invested their entire assets in the fund.

LTCM's structure included strategic partners. Two dozen partners invested at least \$100 million each in the fund in return for access to LTCM's technology, modeling, analytics and investment strategies. In reality, anyone who had worked with the arbitrage group would have known that their modus operandi resembled a neutrino star – a black hole. Things only went into the group. Nothing every emanated from the group who operated with an obsessive secretiveness. The strategic partners were rumoured to include central banks or governments. Competitors grumbled that LTCM enjoyed privileged market information and access to special financing facilities.

Investors paid a 2% management fee on asset under management and 25 % incentive fee on earnings after a threshold level of return.



## Secret Trader's Business

LTCM was vague about how the money would be invested. The buzz words were “relative value” and “convergence” trading. LTCM emphasised research and sophisticated analysis of markets. They spoke of “proprietary” modeling techniques. The principals bristled with indignation if anybody suggested that LTCM was a “hedge fund”. In the early 1990s, being a hedge fund did not quite have the cachet that it does today.

There was allusion to identification of “small pricing discrepancies between securities” and “taking advantage of value discrepancies”. There were “long run equilibrium values” and trading to capitalise on movement away from equilibrium values due to “short term market disturbances”. LTCM was going to purchase “cheap” or “underpriced” securities and “hedge” them by undertaking short sales of “expensive” securities with “similar” characteristics. Profits would result when pricing differences corrected. It was the old buy low sell high and the sell high buy low strategy. There were some old favourites as well - tax arbitrage and the standard carry trades.

LTCM's used leverage, up to 25 times. Individual strategies only yielded small profits. Leverage was needed to accentuate the returns. LTCM assured potential investors that risk would be low because the fund would not take directional risks and outright positions. The low risk would allow the fund to use a lot of leverage.

LTCM did not talk about what would happen if markets did not converge or revert to the blissful equilibrium state. The fund would have to hold positions through to maturity to realise the pricing anomaly. The fund intended to take large positions. The mantra was that relative value trading required assuming positions when temporary market disturbances created trading opportunities. LTCM would provide liquidity to the market.

Myron Scholes explained LTCM's trading strategy to his old mentor at the University of Chicago, Merton Miller, in the following terms: *“think of us [LTCM] as a gigantic vacuum cleaner sucking up nickels from all over the world”*.

## Let the Good Times Roll

LTCM's initial performance was exceptional. The peak was 1995 and 1996 when they generated returns of over 40 % pa. The performance was remarkable given that the risks appeared low. LTCM was living up to its heady billing.

During this time, LTCM was heavily focused on its usual trading strategies perfected during the Salomon years. The high returns and low risks appear in hindsight to have been driven by a fortunate combination of factors. LTCM had hit a sweet spot. They were able to exploit once in lifetime opportunities due to the creation of the single European currency - the Euro - and tax arbitrage opportunities.

In 1997, returns fell to about 17%. US stocks showed returns of 33%. The 1997 performance was disappointing. LTCM had indicated to investors that its risk profile would be similar to that of equity investments. There was also increased competition. New hedge funds modeled on LTCM had set up shop. Investment banks had also set up internal hedge funds imitating LTCM's activities.

LTCM increased leverage. LTCM had used only modest leverage until this point, around 8 times against a permitted 25 times. LTCM returned \$2.7 billion of its total capital of \$7 billion to investors. Most investors were aghast at the mere suggestion that they would be excluded from the high returns that everybody expected LTCM to continue to make for investors. They fought to stay in. New investors sought to get in. LTCM was still a “hot ticket”.

LTCM also “broadened” its trading activities extending them to credit spread trading, volatility trading and equity risk arbitrage - “style drift”. Inevitably, you drift into the path of the mother of all storms.

### **The Perfect Storm**

Following their stellar early years, LTCM found 1998 “challenging”. By September, LTCM had lost 92 % of its capital. Its leverage had increased to over 100 times. Meriwether, unflappable as always, advised that: “we’ve had a serious markdown but everything’s fine with us”.

The 1998 crisis had its origins in the Asian monetary crisis the previous year. The collapse of Asian currencies and equity markets triggered far reaching changes in global markets. Large trading losses had resulted in many traders exiting markets. There was massive uncertainty and a general aversion to risk. There was a flight to quality.

LTCM perceived the increase in volatility levels and credit spreads as a trading opportunity. They placed massive bets on credit spreads (the margin between corporate bonds and government bonds) and stock volatility falling. The principals regarded the market as being driven by a temporary lack of liquidity. LTCM began to act as a liquidity re-insurer. It was now the Central Bank of Liquidity and Volatility.

The crisis developed slowly. In May/ June 1998, LTCM took a big loss in mortgage backed securities. In August 1998, Russia defaulted on its debt. LTCM took losses on its Russian securities. Credit spreads increased triggering large losses on LTCM’s credit spread positions. Investment managers and traders sold further pushing prices down and credit spreads up. Equity markets became more volatile. LTCM appears to have lost around \$550 million on 21 August alone. The losses related to its credit spread and equity volatility positions.

On 2 September 1998, John Meriwether issued a letter to investors that revealed LTCM had lost 52 % of its value. *“As you are all too aware events surrounding the collapse of Russia caused large losses and dramatically increased volatility in global markets....Many of the fund’s investment strategies involve providing liquidity to the market. Hence, our losses across strategies were correlated after-the-fact from the sharp increase in the liquidity premium: the use of leverage has accentuated the losses.”* The letter to investors sought new capital from investors on the basis that *“... since it is prudent to raise capital the fund is offering you the opportunity to invest on special terms related to LTCM’s fees.”* There were no takers.

On 18 September 1998, Bear Stearns (LTCM’s prime broker and principal clearing agent for both exchange and OTC collateral) is rumoured to have frozen the fund’s cash account following a large margin call. On 23 September 1998, AIG, Goldman Sachs and Warren Buffet made an offer to buy out LTCM’s partners and inject \$4 billion into the fund. The offer lapsed. LTCM faced the specter of a massive default that would affect the entire financial system, as large positions would need to be liquidated. Having no real choice, the New York Federal Reserve facilitated a re-capitalisation of LTCM. 14 banks invested \$ 3.6 billion in return for a 90 % of LTCM.

## Weather Forecasts

LTCM had sophisticated risk management systems to quantify the risk of the fund. They had VAR. What had gone wrong with the weather forecasts?

At the beginning of 1998, LTCM's risk was \$45 million at 99% confidence level. This meant that there was only one chance in one hundred that LTCM could lose more than \$45 million. After losses in May/ June 1998, LTCM reduced risk to around \$35 million. Yet in August 1998, LTCM's daily profits and losses were up to \$135 million against the expected \$35 million. In September 1998, LTCM's profit and loss was moving \$100 million to \$200 million daily.

LTCM was done in by a combination of market risk, liquidity risk and hatred. The fund's risk models underestimated volatility and used incorrect correlation factors. LTCM's models assumed that it would be possible to reduce positions across the entire portfolio rapidly. But not all positions were liquid. Losses required selling the more liquid positions first leaving only the more difficult to shift positions.

LTCM's positions were very large reflecting its final incarnation as a liquidity provider to the market. This sharply increased LTCM's losses as it sought to close positions. The market was also remarkably well informed about LTCM's positions.

When the LTCM principals had traded at Salomon Brothers the purpose of specific trades was not apparent to the market. Trades executed by a dealer may be client transactions or proprietary positions. Once the LTCM principals began trading as a fund all the trades were proprietary. LTCM tried to disguise the transactions, separating components and executing them with different counterparties. The size of positions and their nature made them difficult to hide from other traders.

Many dealers established internal hedge funds that worked closely with special sales desks that serviced hedge funds only. Some had been created to specifically serve LTCM. They worked out LTCM's trading strategies and then did the trades for their own account. When their risk limits were full, they marketed the same strategies to other banks and hedge funds established to copy LTCM. When the storm hit in mid 1998, everybody was around the same way as LTCM. This meant that all the traders found that they had put on the same trades. This also meant that they all would have to extricate themselves from these positions at the same time. The only people who seemed to have missed this were LTCM itself. At the time of the crisis Victor Haghani commented that: "it was as if there was someone out there with our exact portfolio only it was three times as large as ours and they were liquidating all at once".<sup>3</sup>

In July 1998, Salomon Brothers shut down their fixed income arbitrage operations. Costas Kaplanis had built a successful operation following the departure of Meriwether's wunderkids. Large losses led Sandy Weill, the boss at CitiGroup that now owned Salomons, to shut down the operation. The sale of the Salomon positions absorbed scarce liquidity.

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<sup>3</sup> See Michael Lewis "How The Eggheads Cracked" (24 January 1999) New York Times Magazine 24-42.

As the storm developed, traders and investment managers began to unwind positions with increasing urgency making LTCM's losses worse and making liquidation of positions more difficult. In August/ September 1998 the rumours of LTCM's problems triggered more selling. The overhang of the massive LTCM portfolio forced other traders to aggressively liquidate positions anticipating LTCM's need to sell. Aggressive trading firms are alleged to have used the situation to force LTCM into default and purchase the portfolio at distressed prices.

Valuations of positions were affected by the conditions. Available prices were affected by a huge liquidity premium. Where prices were unavailable the prices used were often very conservative triggering ever larger mark-to-market losses.

LTCM required investors in the fund to invest for a minimum period of 3 years. This meant that LTCM did not have to worry about investors wanting their money back. They had a different problem. The fund had borrowed to leverage their capital and used derivatives. The terms required LTCM to cover any losses with cash – margin calls.

LTCM had historically borrowed and entered derivative trades on generous terms. Dealers regarded LTCM as “special”. The volume of LTCM's trading were a significant source of earnings for dealers. LTCM's trading had a large impact upon market prices. The dealers liked to understand the fund's trading so as to be able to duplicate them. But as losses mounted, the piper had to be paid. The banks began to howl for blood. Mark Twain once remarked that: *“A banker is a fellow who lends you his umbrella when the sun is shining, but wants it back the minute it begins to rain”*. In the end, LTCM ran out of cash.

The wunderkinds had got it all wrong. They had misread the weather report. The principals at LTCM were experts at interpreting the Greek letters (delta, gamma, theta, rho, vega) used to measure risk. Critics now suggested that perhaps they should have focused on a specific Greek word – hubris, meaning over confidence or insolent pride.

Louis Bacon, the principal of Moore Capital, once remarked that: “There are those who know that they are in the game; there are those who don't know they are in the game; and there are those who don't know they are in the game and have become the game.” By late 1998, LTCM were very much the ‘game’.

#### **The More Things Change...The Case of Amaranth Advisors<sup>4</sup>**

In August/ September 2006, Amaranth, lost \$6 billion after massive natural gas trades went awry. The loss was almost twice the loss when LTCM collapsed. Interestingly, it does not seem to have caused any obvious concern in the market.

Amaranth was a multi-strategy hedge fund. Amaranth Advisors started life as a convertible arbitrage fund (a relatively low risk trading activity). The fund was a recent entrant into energy trading – an infinitely more volatile activity. Just before it blew up, the hedge fund had assets of \$9.2 billion. Amaranth's investor base is believed to include funds of funds at major investors such as Goldman Sachs, Morgan Stanley, Credit Suisse, Bank of New York, Deutsche Bank and Man Group. Amusingly, Amaranth claimed to have best-practice risk management.

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<sup>4</sup> See Hilary Till (2006) Comments on the Amaranth Case: Early Lessons from the Debacle; EDHEC Working Paper; Chris C. Finger “The Lights Are On?” (October 2006) RiskMetrics Group – Research Monthly

Amaranth made significant returns from energy trading in 2005. In 2005, Brian Hunter, a 32-year old Canadian, made a bet that natural-gas futures would rise. Surging gas prices following Hurricane Katrina made large trading gains for the fund. Hunter placed a similar bet in 2006. The major strategy was to buy the March 2007 natural gas futures contract, while shorting the April 2007 futures. The trader wanted to profit from the fact that, historically, natural gas prices increased during winter fell after March as demand for heating by consumers decreased. Natural gas prices started falling in early September 2006 as supply became readily available. The trader was hoping that either a hurricane or a cold season in the US would eventually push natural gas prices upward.

Unfortunately, the weather did not co-operate. A relatively uneventful hurricane season in the US meant that the March/April 2007 natural gas spread fell sharply in September. Amaranth's trade, which would profit in a widening spread environment, was plunged into negative territory as the March/April spread narrowed from 2.05 points on September 1 to 0.75 points on September 18.

The case of Amaranth shows significant parallels to LTCM:

- **Risk Analysis** – Amaranth believed that they were involved in a low risk activity – “arbitrage”. This was based on the fact that they had offsetting position – long/ shorts. In reality, such a position is inevitably exposed to correlation changes – the relationship between the two components changing. Inevitably, correlation changes take place rapidly – like a piece of elastic snapping. It is difficult to either anticipate or take corrective action when it occurs. On September 22, Nick Maounis, founder and chief executive of the fund, highlighted the key reason for the losses. “A series of unusual and unpredictable market events caused the funds' natural gas positions, including spreads, to incur dramatic losses”. Correlation bets like the ones that Amaranth and LTCM took are heavily exposed to “event risk”.
- **Risk Models** – Nick Maounis after the losses surfaced, noted: “Although the size of our natural gas exposure was large, we believed, based on input from both our trading desk and the stress testing performed by our energy risk team, that the risk capital ascribed to the natural gas portfolio was sufficient”. It is questionable that the risk models used were appropriate. For example, correlation risk (one of the main risks in relative value trading) is not generally well captured in traditional risk models. A cursory review of the events shows the inherent limitations of the risk models used. Amaranth took approximately 80 trading days to make \$2 billion through the end of April and approximately 20 trading days to lose \$1 billion in May 2006. Amaranth also took twelve trading days to lose a reported \$4.44 billion through September 18th or a daily average of close to \$ 370 million. Further, when the sale of the energy book was announced on Wednesday, 20 September, the losses were approximately \$6 billion and the average daily loss for September expanded to \$ 420 million per trading day.

- Liquidity risk** - Amaranth had a concentrated, undiversified position in its natural gas strategy. The trader had used leverage to build a very large position. Amaranth's positions were staggeringly large, representing around 10% of the global market in natural gas futures. For those of us with an eye to history, LTCM, at one stage, was about 10% of the global US\$ interest rate swap market. One study inferred the size of the positions from the reported gains and losses in the firm's energy book. On a high-activity day, the market trades more than 100,000 contracts, while in quieter times that figure might only be 50,000-60,000. It is estimated that Amaranth held well over 50,000 natural gas contracts. There are other more obvious signs of the liquidity risk. In an interview in July 2006, Bruno Stanziale, a former Deutsche Bank colleague of Brian Hunter and now at Société Générale, commended Mr. Hunter contribution to society at large. Hunter and Amaranth were, it seemed helping the market function better and gas producers to finance new exploration, such as by agreeing to buy the rights to gas for delivery in 2010. "He's opened a market up and provided a new level of liquidity to all players". Mr. Stanziale seemed to have confused Hunter with the now beatified late Mother Theresa. Hunter's trading provided telling clues. He is alleged to have bought increased numbers of contracts that he already owned, presumably attempting to drive up prices of contract he already owned. This is known as the Nick Leeson gambit in trading. Of course, when the losses occurred, Amaranth could not exit its positions due to the lack of liquidity. "The markets provided no economically viable means of exiting those positions. Despite all our efforts, we were unable to close out the exposures in the public markets." Nick Maounis moaned in a regretful aria that reprised the song made famous by the principals of LTCM in 1998. In the end, Amaranth were forced to transfer its energy positions to JP Morgan Chase and Citadel Investment Group at an apparent \$1.4 billion discount to their mark-to-market value. Compounding the losses to investors.

As with all losses, the markets had the last word. As news got around of Amaranth's problems, other traders took advantage of its problems to make money. One trader was quite open: "When people get a sense that someone is on the ropes, they're going to exacerbate the problems that he has, Those with risk capital are going to short whatever he has, believing the guy will have to capitulate and that they will be there to take his capitulation selling".

But what of the sophisticated fund-of-funds that had investments in Amaranth. It shouldn't have been a surprise. Amaranth's losses followed the failure of another US hedge fund, also due to natural gas trading. MotherRock, an energy-focused hedge fund with \$400 million under management, collapsed in late July 2006. Perhaps like Amaranth their sophisticated risk management systems had been caught by surprise. A spokesman for Amaranth gave the following detailed analysis of the losses: "*We did not expect that the market would move so aggressively against our positions!*"

Perhaps like with LTCM the returns had dazzled them. A sad reality of risk management failures is that most people tend not to look beyond the profits to the reasons on which it depends. In a speculative environment this critical ability greatly diminishes.

John Maynard Keynes once observed that "the market can remain irrational longer than you can remain solvent". In the practice of quantitative finance, the best advice that one can offer is something from over 100 years ago. Mark Twain once remarked: "It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so."

## New New Risks

Risk management constantly changes. Perhaps, it is to make it more difficult to measure progress or achievement.

The focus is now on operational risk or ERM (enterprise risk management). ERM focused on integrating risk; providing a holistic view of risk. Around 1999, I met an ERM advocate, Dudley, the head of risk for an investment bank. He wanted to meet me. I had no idea why. I soon discovered that Dudley had reached ERM. It was the “new”, best-est thing. It was revolutionary. Dudley was at the forefront. He would give me an example of the problems he was trying to model.

“Let’s say our head trader has a complex trading strategy only he understands, yes”. I nodded. I didn’t think any strategy could be that complex, at least if a trader had put it on. But it was quite likely that no one knew about it. The trader may have not told anyone. “Let’s say the trader bicycles to work”. I did not think this likely. Traders prefer Porsches. Not wishing to prolong the discussion, I did not disagree.

“On the way to work, he is hit by a bus. His mobile phone is knocked away from him and damaged. He is unconscious. Assume that simultaneously market prices move due to surprise news. This news is vital to the trader’s position. He does not know. Nobody knows what to do with his position”. I nodded. “That’s not all. Assume simultaneously, there is fraud in another bank”. I nodded in real agreement. That was very likely. “This bank goes into bankruptcy. It creates a financial crisis. This of course affects the trader’s position. He doesn’t know of course. He’s unconscious”. I was hoping he would get to the point soon.

“At the same time, assume there is an accident at a power plant. There is a blackout. The bank’s back-up generator fails. The mechanic forgot to check the fuel tank. The bank’s computer system goes down. The trader can’t get prices or model the risk on his position”. I reminded Dudley that the trader was unconscious, maybe deceased. “Exactly”, he replied cheerily. It went on.

Eventually after a tragedy of biblical proportions had been outlined, Dudley reached the end. “I am modeling the probability that such an event could occur”. For me, it was one step too far in the search for “holistic risk”. Risk management seemed to have completed its transformation into pure entertainment. Dudley seemed the epitome of a risk manager who would drown crossing a river that was 12 inches in depth *on average*.

Risk itself has changed significantly<sup>5</sup>. Financial crises are less and less the result of economic downturns, geopolitical events or natural disasters. They are more and more the result of the structure and activity in financial markets.

Financial crises now do not necessarily mirror the underlying real economy. Economic cycles have become less pronounced. Variability in GDP has actually reduced. This is result of government actions – primarily improvements in information and monetary and fiscal policies. At the same time the complexity and inter-connections within the financial markets have increased. With this risk has both changed and increased.

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<sup>5</sup> See Richard Bookstaber (2007) *A Demon of our Own Design*; John Wiley, Hoboken, New Jersey at 2-6.

Recent crises have a strong financial component. For example, the 1987 stock market crash was arguably triggered and exacerbated by portfolio insurance. The 1997/98 emerging market crash was intimately tied to the activities of LTCM. The 2005 credit market crises and the 2007 sub-prime debacle were tied to problems in the structured credit markets.

The real risk in markets is now driven by a combination of the following:

- **Structure of markets** – the design of markets, flawed regulatory regimes and the nature of cross border capital flows contribute to risk. Increasingly tight coupling of markets create complexity and interdependence. Consolidation within the financial services industry creates increasing levels of concentration of trading and risk within a small group of large dealers.
- **Financial innovation** –the impact of new market participants (such as hedge funds) and new products is poorly understood. Innovations allow trading of new risk factors such as correlation, volatility skews and liquidity risks that are neither transparent nor properly priced. Complex instruments are difficult to value with accuracy. Credit enhancement techniques such as collateralisation facilitate increased borrowing and higher leverage. The arcane effect of highly technical credit documentation and operational risks posed by complex products are not captured by risk systems.
- **Risk dispersion or concentration** – trading transfers risk within the system in complex ways. Hedge funds are seen as providing liquidity and dispersing risk. In reality, trading strategies are often poorly diversified. They involve large bets on the *same event* using different instruments. This creates higher volatility under certain conditions. Large marquee hedge funds and prime brokers (who finance these hedge funds) also create significant risk concentrations.
- **Model risks** – the models used to price, risk manage and value instruments frequently do not accurately capture the underlying market and asset price dynamics. Assumptions about trading liquidity and funding are unsustainable. Mark-to-market is increasing mark-to-model, which vary significantly between dealers. Similar risk models used by regulated entities create dangerous negative feedback loops.
- **Trading behaviour** - trader activity and interactions are poorly understood. Moral hazards are prominent in compensation systems for traders.

Many of these elements don't lend themselves to fanciful mathematical modeling and exactness beloved of risk mangers. The real risks remain unknown unknowns.

In the early days of risk management, the risk manager in one London bank prominent in derivative trading was reputed to be a large individual armed with a spreadsheet and a baseball bat. Perhaps, risk management going forward may well be a case of back to the future.

### **Sum of All Your Fears**

In this world there exists arithmophobia – the fear of numbers. There's also chrematophobia – fear of money, plutophobia – fear of wealth and phobophobia – fear of fear. Risk management is the sum of all these fears.



Risk management is now well established. Firms have a CRO (Chief Risk Officer) to go with the CEO, COO, CFO and CIO. This was a step up from one London bank prominent in derivative trading where the risk manager was reputed to be a large individual armed with a spreadsheet and a baseball bat. The strange thing is that the increased emphasis on risk management does not seem to be matched by results. Banks regularly register large losses that risk systems were designed to protect against. The defense is opaque. You don't know what losses risk management has saved you from, an unknown unknown. It is reasoning worthy of Lewis Carroll: "the rule is jam tomorrow and jam yesterday – but never jam today".

Risk management is real. It has a clear purpose. Banks must take risks in order to make money. Increasingly, banks have to take more and more risks as client business just doesn't pay - "great deeds are usually wrought at great risks". The unpalatable truth is that banks must roll dice to pay the light bills and have something left over for the shareholders.

In 2004, one bank suffered losses of around \$360 million in trading. An "independent" inquiry revealed many shortcomings. The bank's Board of Directors recognised risk was a "key" issue but did not seem to be much concerned with it. The Audit Committee seemed interested in process rather than in getting to the bottom of troubling inconsistencies. The Risk Committee seemed to meet infrequently and did not rouse themselves to look at breaches of risk limits. Risk management meetings seemed to be called not to do business but to do no business. Perhaps they were called not because there was risk management to be done but because it was necessary to create the impression that risk management was being done.

When the scandal emerged, the Boardroom erupted in an unseemly brawl as directors feuded about who should stay and who should resign. To the casual observer, it would seem to be a case of the epic achievement of the captain and crew of a sinking ship shouldering aside women and children to save themselves. The risk manager, of course, lost his job.

Risk management is the fig leaf behind which risk taking hides. The risk manager is there as the fall guy to protect the chairman, directors and management. Risk management is an insurance plan for directors and senior management. Mathematical finance is there to lend credibility and false precision to this dismal reality of risk management. Even the pseudo classicism of derivative traders, quants and risk management is false. In fact, Vega, one of the trader's "Greeks" (the measures of risk), is not actually a Greek letter.

Banks make a lot of money trading. Traders make fat bonuses from trading. The bonus system is the ultimate derivative trade. Traders risk the bank's capital. They literally bet the bank, at least up to their limits. If they win then they get a share of the winnings. If they lose, then the bank picks up the loss. Traders might lose their jobs but the money at risk is not their own. It's all OPM – other people's money. It is the ultimate in capitalism – the privatisation of gains, the socialisation of losses.

In the late 1990s, a headhunter approached me about a risk management role. Headhunters still considered me to be employable. Potential employers thought my skepticism humorous and not beyond redemption. I had no intention of taking the role. Flattered, I flirted. We got to a discussion of compensation.

I proposed a simple formula. My annual compensation would be equivalent to a put option on the value of the stock entitlement of the chairman, directors and management. The put option would be struck at the current share price. The logic was simple. If there were losses then the share price would fall. My job was really to protect the wealth of the shareholders, at least a small group of them. My salary would be equal to the price of insuring losses on the shares held by the bank's key decision makers. The value of the option would have made me the highest paid employee of the bank.

The employer and headhunter laughed. I was serious. As the risk manager, I was setting myself as the fall guy. If anything went wrong then I would have to commit ritual suicide to protect my masters. I was happy to make this sacrifice. I just had my price.

### **Risk – The Unknown Knowns**

An unbiased and ruthlessly objective analysis of risk management shows it to be a triumph of aesthetics over truth. However, this does not necessarily make it bad or lacking in utility. For example, the risk management industry provides employment to millions of people worldwide directly or indirectly.

In 1971, Galbraith had the following comments of man's, specifically American man's, journey to the moon. *"Most of the descriptions and pictures of the moon I have seen make it out to be rather a questionable piece of property. The absence of atmosphere would seem to be a real handicap. Likewise of water. The climate is predictable if poor. ... Yet these and similar shortcomings show no signs of limiting the enthusiasm to get there. ... Though not an inexpensive adventure, it may be worth pursuing for no particular reason."*<sup>6</sup> Galbraith, an astute observer of human activity, noted that *"one of the generally amiable idiosyncrasies of man is his [or her] ability to expend a great deal of effort without much inquiry as to why"*.<sup>7</sup> Risk management as a discipline exemplifies that idiosyncrasy.

The role of risk management is poorly defined. Risk is misunderstood. Form rather than substance dominates. Risk models are flawed, sometimes fatally. After the next great crash, risk management, as it currently stands, will only be good for the last part of the great risk hunt – the hunt for knowledge. Risk managers will be left to examine "what happened".

Activity and achievement are frequently confused in modern times. In risk management, there is frenetic activity. It will be interesting to see whether in the crucible of reversing markets, there is achievement. Perhaps it is best to heed Mark Twain's advice: *"Don't part with your illusions. When they are gone you may still exist, but you have ceased to live."*

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<sup>6</sup> See from *The Proper Purpose of Economic Development* in John Kenneth Galbraith "The Essential Galbraith" (2001, Houghton Mifflin Company) at 109,110

<sup>7</sup> See from *The Proper Purpose of Economic Development* in John Kenneth Galbraith "The Essential Galbraith" (2001, Houghton Mifflin Company) at 109,110

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The above is adapted from *Traders Guns and Money: Knowns and Unknowns in the Dazzling World of Derivatives* by Satyajit Das (2006, FT - Prentice Hall, London, ISBN 0273 70474 5) available at all good book stores or online at [www.pearson-ed.com](http://www.pearson-ed.com).

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