



How to Lose Money in the Financial Markets: Examples from the Recent Financial Crisis

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1. Introduction

What makes financial institutions, banks, and hedge funds fail? The common ingredient is over betting and not being diversified enough 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, with the hope of exiting the problem with a profit. Incentives, including large fees on gains and minimal penalties for losses, push managers into such risky behavior. We discuss some specific ways losses occur. To illustrate, we discuss cases from the recent financial crisis, including subprime mortgages. We also list other hedge fund and bank trading failures with brief commentaries.

2. 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 derivatives industry deals with products in which one party gains what the other party loses. These are zero-sum game situations. Hence there will be large winners and large losers. The size of the gains and losses are magnified by leverage and over betting, leading invariably to large losses when a bad scenario occurs. This industry now totals over \$700 trillion, the majority of which is in interest and bond derivatives with a smaller, but substantial amount in equity derivatives.

Categories of Losses

Figlewski (1994) attempted to categorize derivative disasters and this article discusses and expands on that framework:

A. 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.

B. 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 theoretical advantage. In addition, one may lose more if the counterparty defaults because of fraud or following the theft of funds, as was the case with MF Global in 2011.

C. Speculation

Derivatives have many purposes including transferring risk from those who do not wish to have exposure to it (hedgers) to those who do (speculators). Speculators who take naked unhedged positions make the purest bets 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 lost bonuses. 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 some of the time, 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 case of Niederhoffer (see Lleo and Ziemba, 2014a). Since trades between large institutions frequently are not collateralized mark-to-market, large paper losses can accumulate without visible signs, such as margin calls. Nick Leeson's loss in early 1995, 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 the 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 other bonds lost considerable sums as well, since interest rates rose quickly and significantly.

D. 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 19, 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&P 500 cash market. Forced liquidation due to margin problems becomes more difficult when others have similar positions, and in similar predicaments, this leads to contagion. The August 1998 problems of Long Term Capital Management in bond and other markets were exacerbated because others had followed their lead with similar positions. When trouble arose, buyers were scarce and sellers were everywhere.

Another example is Metallgesellschaft's crude oil futures hedging losses of over \$1.3 billion. They had long-term contracts to supply oil at fixed prices for several years. These commitments were hedged with long oil futures. 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-market futures losses. A management error led to the unwinding of the hedge near the bottom of the oil market and hence triggered the disaster.

Potential problems are greater in illiquid markets. Such positions are typically long-term and liquidation must be done matching sales with potentially few available buyers. Hence, forced liquidation can lead to large bid-ask spreads. Askin Capital's failure in the bond market in 1994 was accelerated because they held very sophisticated securities that were only traded by a few counterparties and contagion occurred. Once the buyers 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.

E. Misunderstanding the risk exposure

As derivative securities have become more complex, so have the requirements for their full understanding. The Shaw, Thorp, and Ziemba (1995) Nikkei put warrant trade (discussed in Ziemba and Ziemba, 2013) was successful because they did a careful analysis to price the securities fairly. In many cases, losses are the result of unsophisticated investors trading in high-risk financial instruments. Lawsuits have arisen where such investors attempted 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,

judges, and juries find derivatives confusing and risky, even when they are used to reducing risk, such lawsuits or the threat of them, may be successful in achieving some recovery for the investors.

One great exposure to risk lies in the extreme scenario, which investors often assume has zero probability when in fact a given event may have a low but positive probability. Investors are generally unprepared for interest rate, currency, or stock price changes so large and fast that they are considered to be impossible. The move of some bond interest rate spreads to 17% in August/September 1998 from 3% a year earlier led even savvy investors and sophisticated Long Term Capital Management researchers and traders down this road. They had done extensive stress testing with a VaR risk model that failed when the August 1998 Russian default (involving the extreme low probability event) took place, which was exacerbated by changing correlations. To avert this situation, one should use several scenario-dependent correlation matrices, rather than relying on simulations around the past correlations from a single correlation matrix. This is implemented, for example, in the Innovest pension plan model, which does not involve levered derivative positions (Ziemba and Ziemba, 2013). The key to staying out of trouble, especially with highly levered positions, is to consider the possible futures fully and to have enough capital or access to capital to weather bad scenario storms such that any required liquidation can be done in an orderly fashion.

Figlewski (1994) observes that the risk in mortgage-backed securities is especially difficult to understand. Interest-only (IO) securities, which provide the interest part of the underlying mortgage pool's payment stream, are a good example. When interest rates rise, IOs rise since prepayments are reduced and the stream of interest payments is larger. However, when rates rise sharply, the IOs fall 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 has caused similar losses. Scenario-dependent matrices are especially useful in such situations.

F. Forgetting that high returns involve high risk

If investors seek high returns, then they will usually have to withstand some large losses. The Kelly criterion

strategy and its variants (MacLean, Thorp, and Ziemba, 2011) provide a theory to achieve very high long-term returns, but acknowledge that 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.

G. How over betting occurs

Exhibit 1 shows how the typical over bet situation occurs, assuming that a Kelly strategy is being used. The top of the growth rate curve is at the full Kelly bet level, which 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 $f = 1/(1-\alpha)$. So $u(w) = -1/w$ corresponds to 1/2 Kelly with $\alpha = -1$. Over betting is to the right of the full Kelly strategy and it is clear that betting more than full Kelly gives more risk, as measured by the probability of reaching a high goal before a lower level curve on the exhibit. It is in this area far to the right where over betting occurs. Virtually all of the disasters occur because of over betting.

Stochastic programming models provide a good way to try to avoid problems by carefully modeling the situation at hand and considering the possible economic futures in a systematic and 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. 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 in modeling 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) explores such models more deeply 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 variation of standard finance CAPM type theory modified for fat tails and C-VaR or expected tail losses for the losses. Ziemba (2003, 2007, 2013) presents an 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 to avoid over betting, to have access to capital once a crisis

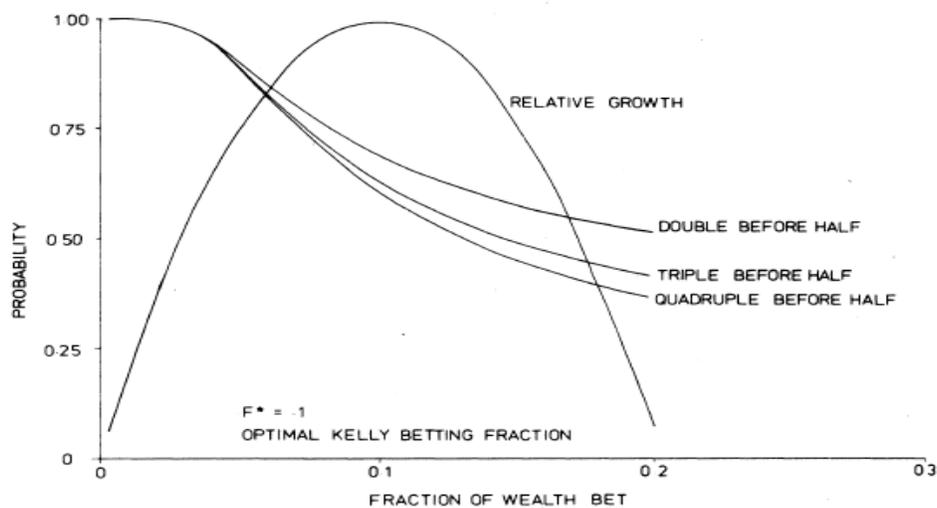


Exhibit 1: Relative growth and probabilities of doubling, tripling, and quadrupling initial wealth for various fractions of wealth bet for the gamble win \$2 with probability 0.4 and lose \$1 with probability 0.6.

Source: MacLean, L.C., Ziemba, W.T., and Blazenko, G., "Growth Versus Security in Dynamic Investment Analysis." *Management Science* 38.11 (November 1992).

occurs, and to plan in advance for such events.

3. Possible utility functions of hedge fund traders

One way to rank investors is by the symmetric downside Sharpe ratio (DSSR) (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 1969-88 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 CISDM hedge fund data studied in Gergaud and Ziemba (2012).

The results come from the choices made using a utility function. Those seeking high DSSRs are investors who are 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 two, three, and four per year respectively.

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

1. $x\%$ of the time the fund blows up and loses 40%+ of its value; 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) or (3), that is, the total positions are over bet, not diversified, and move markets. There is no plan to exit the strategy since it is assumed that trades can be made continually. In a multi-period or continuous time model, it may well be that for the fund manager's or trader's specific utility functions, it is optimal to take bets that provide enormous gains in some scenarios and huge 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 Advisors (2006) and similar rogue trading situations, there are additional complications such as the fund manager's utility function and his wealth stake inside and outside this fund. 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 Brian Hunter at Amaranth, 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 to increase bets when so much is already in the bank. Recall in LTCM, that they had obtained a \$100 million unsecured loan to invest in their fund. Finally, in such analyses, one must consider the

The trading losses at Societe General 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	\$2.6 1996	Copper futures	Hamanaka pleaded guilty to fraud; Sumitomo paid a \$150 million fine.
Barings Bank Nicholas Leeson	\$1.4 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.

Exhibit 2: Rogue traders, trading losses, and outcomes

Source: *Wilmott* magazine

utility functions and constraints of the other investors' money. In the case of Amaranth, Deutsche Bank, which had first-hand knowledge of Hunter's previous trading blowups, was an investor along with other well-known firms.

4. Financial disasters before 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 a late 1928 stock price of \$104, rising to \$222.50, and down to \$1.75 by 1932. Irving Fisher (the distinguished Yale Economics Professor) stated in 1929, "stock prices have reached what looks like a permanently high plateau" just prior to the big crash. He lost millions, but Yale rescued him.

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

- A notoriously short financial memory of twenty years or less creates the conditions for a market collapse.
- The critic must wait until after the crash for any approval, not to say applause.
- 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.
- Something new: reinvention of the wheel over and over again, often in a slightly more unstable version.
- Debt is secured by real assets.
- Leverage is extreme.
- After the crash there is anger towards those previously most admired and scrutiny of the previously much-praised financial instruments and practices; there is also talk of regulation and reform.
- Not discussed is the speculation itself or the optimization behind it.
- The reality is all but ignored.

Litzenberger and Modest (2009) mention other trading losses and financial crises. Bad judgment, difficult times, and various levels of secrecy bordering on or actually constituting fraud are rampant in some cases. In

this section, we present a chronology of the major financial and trading disasters that have taken place since the 1980s.

5. 1980-2007: banks in turmoil, derivatives blowups, and rogue traders

Hunt Brothers (1979-80): Herbert and Nelson Hunt, the two sons of oil tycoon H.L. Hunt, took the view that the price of silver would greatly appreciate 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 world's silver market. The price of silver topped \$50 per ounce. Eventually, the U.S. commodities regulators introduced futures trading curbs, effectively stopping the Hunt Brother from adding to their position. As demand dried up, the silver market stalled, and the Hunt brothers faced mounting margin calls. At first, the brothers met their margin calls by borrowing against their family's assets. However, the Federal Reserve intervened, persuading 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 offering competitive rates to their depositors. 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 and the S&Ls began to lose their customer base. To stay 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, and offering higher rates to their depositors. However, many S&L institutions had neither the expertise nor the manpower required to deal with these new types of risk. Up to a third of the 3,234 S&L institutions failed over

the period 1986-1995: 296 of them were closed by the Federal Savings and Loan Insurance Corporation (FSLIC) between 1986 and 1989 and a further 747 S&Ls 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. We refer the reader to the detailed account given by Pyle (1995).

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 deposits in the U.S. with \$40 billion in assets. A large part of the blame for Continental's insolvency may be attributed 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 Oklahoma, after Penn Square's failure in July 1982. Continental's woes were compounded by fraud committed by a number of lending officers led by John Lyte. By May 1984, rumors of an impending 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 Too Fail,' remained the country's largest banking failure until Washington Mutual collapsed in 2008.

Black Monday (1987): World markets plunged on Monday, October 19, 1987. The Dow Jones Industrial Average fell by 508 points to 1738.74, a 22.61% drop. Futures contracts sank 29% after trading at a discount throughout the day. The Bondstock Earning Yield Differential (BSEYD) model predicted this in April 1987, based on high interest rates relative to stock earnings (Ziemba, 2003).

Drexel, Burnham, and Lambert (1990): Drexel, Burnham, and Lambert was the largest and most influential institution in the junk bond market. Several of its leading members were 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 Salo-

mon 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 investment in a 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 amounted to some 8% of the investment pool's assets and 21% of its equity. On December 6, 1994, the county declared bankruptcy and began liquidating its portfolio.

Jorion (1997) pointed 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 liquidated its portfolio. If the county had held on to the portfolio, Miller and Ross estimated that Orange County would have erased the losses and possibly even have made some gains in 1995.

Barings (1995): Nick Leeson incurred a \$1.3 billion loss that bankrupted Barings PLC, a bank that had operated for well over 200 years. While based in Singapore, Leeson had accumulated long positions in Japanese Nikkei 225 futures with a notional value totaling \$7 billion. As the Nikkei declined, Leeson hid his losses in a “loss account” and increased his long positions, hoping that a market recovery would return his overall position to profitability. However, on January 17, 1995, Japan suffered an earthquake in Kobe and the Nikkei declined by about 15 percent. 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 in the futures section of Barings Singapore was a leading contributor to this disaster because it allowed him to take very large positions and hide his losses. Another factor was the blurry matrix-based organization chart in use at Barings. In these charts, roles, responsibilities, and supervisory duties were not clearly assigned. This created a situation in which regional desks were essentially left to their own devices. Leeson went to prison in Singapore and now lectures for about £10,000 per talk.

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. The trades resulted in the accumulation of approximately \$2.6 billion in losses over 13 years.

Enron (2001): In this case, energy trade failures were compounded by fraud and corruption. 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 and 1999.

- Enron’s management was under pressure to support both the stock price and the 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 the mark-to-market method for certain types of contracts (other than what is permitted by U.S. GAAP for inventory of commodities) was unusual.
- Engaged in securitization of assets in its so-called price-risk-management business: report assets sales to special purpose entities with inflated values, reported a gain on sale of a portion of a joint venture 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 balance sheet). Under the equity method of accounting, Enron should have reported its percentage share of GAAP income on its income statement, and not used the 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 transactions were recorded.
- Related party transactions: Enron entered into transactions including receivables, derivatives, and sales of assets with a limited partnership (the Related Party) whose general partner and managing director was 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-downs related to these activities were announced in October 2001. There were also ample red flags outside of the 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).

For further information on Enron, see Douglass, Yu, and Ziemba (2004), which discusses the pension losses of employees. They compare mean-variance with stochastic programming fat tail models and include the ef-

fect of job loss in addition to pension value loss.

Allied Irish Bank (2002): Currency trader John Rusk, working for a small subsidiary in Maryland, 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.

6. 2007-9: The subprime crisis

Bear Stearns (2007): From 2005 to the end of 2007, Bear Stearns pursued an aggressive strategy, relying heavily on leverage (35.6 times) to increase its profit, holding large quantities of derivatives, and launching a number of credit-linked 'hedge funds.' At the end of 2007, Bear Stearns held derivatives with a notional value of roughly \$13.40 trillion and it had become the seventh largest securities firm in the U.S. by capital and ranked among the most admired firms in the country. By March 2008, Bear Stearns had joined the vastly less prestigious list of failed financial institutions.

The cracks had appeared in the first half of 2007, when rumors circulated that 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 Stearns effectively bailed out the Bear Stearns High-Grade Structured Credit Fund with a \$3.2 billion loan, an amount 100 times larger than the firm'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 Stearns was forced to admit that the two funds had lost almost all 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 triggered a loss of confidence in Bear Stearns. This made it more difficult for the firm to finance its highly leveraged balance sheet and ultimately led to its failure. Bear Stearns was acquired by JP Morgan Chase on March 16, 2008 in a deal brokered and partly financed by the Federal Reserve Bank of New York.

Merrill Lynch (2007): Based in New York City, Merrill had about 15,000 financial advisors, \$13.8 billion in revenue in 2012, and \$2.2 trillion in client assets; it is

the world's largest brokerage firm. Prior to 2009, it was Merrill Lynch and Co - it was merged into the Bank of America on September 14, 2008. The firm dates back to 1914, when Charles Merrill and Edmond Lynch joined forces. 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 (*Time*, 1964) and Merrill's large brokerage network named "the thundering herd" allowed it to sell securities it underwrote directly, giving them an edge on other Wall Street firms.

On one hand, Merrill drove innovation in financial services; *Fortune* magazine called Merrill's Cash Management Account, where credit cards, check writing, and money market mutual funds came together, "the most important innovation in years" (*Fortune* 1980). On the other hand, its reputation was not sterling; Merrill had a hand in the Orange County disaster. Merrill and other financial institutions were accused of selling risky ill-advised 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, collecting \$600 million back - of which \$400 million was from Merrill, which settled without admitting liability in June 1998.

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 2006-7. The CDOs were declining in value in late 2007 but Merrill held most of them, which led to the losses. In November 2007, they wrote down \$8 billion in losses, removed E. Stanley O'Neal as its head, and replaced him with John Thain. Thain raised \$6 billion by 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. This brought total losses from July 2007 to July 2008 to \$19.2 billion. The firm then sold securities and hedge funds to Temasek for \$3.4 billion.

In August 2008, Andrew Cuomo, New York Attorney General, threatened to sue Merrill, suggesting that they had misrepresented the risk of mortgage-backed securities. They responded by offering to buy back \$12 billion MBS at auction. They then cut costs, froze hiring, and

charged \$30 billion in losses to their UK operations, thus avoiding taxes there. By mid 2008, they sold one tranche of CDOs originally worth \$30.6 billion for \$1.7 billion cash plus a \$5.1 billion loan to Lone Star Funds.

In March 2009, Merrill reported that they had received billions from insurance with AIG and \$6.8 billion of AIG's government bailout. Even in disgrace, the misbehavior continued; especially troublesome to some observers was the fact that 36.2% of the TARP money received for the bailout, some \$3.6 billion, went to executive bonuses. The bonuses were announced on December 8, 2008 after Bank of America had approved the merger, but before Q4s financial results were announced. Criticism of actions like this has led to a somewhat better approach toward 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 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 deep interconnections combined with the refusal of the U.S. government to bail Lehman out was a major factor in pushing the stock market lower that fall. The Dow Jones Average fell 4.4% on September 15 and another 7.0% on September 29. Meanwhile the S&P 500 futures fell 9.74% in September, 20.11% in October, 9.22% in November, and 44.2% for the year in 2008.

The Lehman bankruptcy is yet another example of over betting, lack of diversification, and being hit by a bad scenario. Lehman had a huge amount of debt, with leverage of 31-1. In this situation, a 3-4% decline in the value of its assets wiped them out. There were over 100 hedge funds that used Lehman as their prime broker. These positions, with a value of over \$400 billion, were frozen. Lehman, like others, got drawn into the sub-prime mortgage market. They securitized low rated mortgages of poorly financed homebuyers including some "Ninja" loans to those with no money, no job, and no assets. These types of loans may work in a rising real estate market, but as we know, the real estate market peaked in 2005-6 and then fell sharply in most areas of the U.S. By the second quarter of 2008, Lehman reported losses of \$2.8 billion and their stock fell 73% in

Q1 and Q2 of 2008. They released 1,500 people (6%) just before the Q3 reporting period that year.

There were some options for bailouts. One was the Korean Development Bank whose low offer of \$6.40 per share was rejected by Lehman; it was also 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&P 500. On September 10, Lehman announced a \$3.9 billion loss. The New York Fed, led by Timothy Geithner, considered a bailout with the involvement of Barclays and Bank of America. However, the Bank of England and the FSA in London were against this. The Bank of America dropped out when U.S. Treasury Secretary Paulson refused to insure part of the losses.

After the bankruptcy, JP 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 division, including Lehman's midtown Manhattan office building valued at \$960 million, for \$1.29 billion. With Barclays back in the game and no alternative, the deal went through. Barclays received \$43 billion in securities and \$45.5 billion in liabilities. On November 22, 2008, Nomura purchased Lehman's Asian holdings.

While Lehman collapsed, Lehman Futures survived during the dark days of September 2008. This is a good illustration that futures exchanges, unlike banks and shadow banks, have remained financially stable.

AIG (2008): The U.S. government made an \$85 billion bailout when the American International Group, a multinational insurance company with 63,000 employees in more than 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. 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 risky mortgages and bought mortgage-backed securities. When losses occurred in 2007, they had to pay insurance claims and collateral account losses. On June 15, 2008 Sullivan resigned amid the losses and stock price decline. In late 2008, AIG suffered still more due to the financial crisis and their own over betting on toxic levered assets including subprime loans. The credit default swaps lost a lot of money.

AIG's credit rating was downgraded, so the firm had to put up more margin money. By September 16, 2008 AIG was essentially bankrupt. The U.S. Fed bailed them out with \$85 billion, with 70% of the company's stock going to the government. This was the largest bailout of a company in U.S. history. And yet the troubles continued. Huge executive bonuses in 2009 of \$165 million to executives and total bonuses of \$1.2 billion led to bad PR and the losses continued. There were more government loans and stock offerings totaling \$182.3 billion, but eventually AIG paid back \$205 billion so the government made a profit (Sjostrom, 2009; Greenberg and Cunningham, 2013).

Citigroup Inc. (2008): Citi dates from 1812 and, in 2012, was the third largest bank in the U.S., with the shareholders including funds from Singapore and the Middle East. Citi sustained enormous losses in 2008 from subprime mortgages and CDOs combined with poor risk management. The firm was bailed out in November 2008 by the U.S. government TARP, which 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 Citi \$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 had repaid the bailout loans and the government made a profit of \$12 billion from the sale of shares. Citi recovered from the crisis and became one of the best-capitalized banks in the world, although they failed the Fed's stress test in 2012.

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 detailing the reasons for its losses (UBS, 2008). In October 2008, the Swiss central bank announced its intention to take \$60 billion of toxic assets off UBS's balance sheet and to inject \$6 billion of equity capital.

7. 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. Countries fearing contagion when banks and other large investment vehicles fail, continue to bail them out. Sometimes these bailouts made 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 blowups will occur.

There was much debate concerning the true necessity and value of the U.S. 2008 bailouts, irrespective of whether or not they ultimately made a profit. It is hard to estimate the economic value that would have accrued if the institutions that were bailed out had been required to adjust the mortgages as well. The 56% drop in the S&P 500 from the 2007 peak to the March 2009 bottom, indicates that action was needed, however, developing a better understanding of extreme scenarios and more stringent restrictions in the event of future bailouts are strongly advised.

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