Risk Management Lessons from Madoff Fraud

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Outline

1. Market risks are taken by investors, not by the fund manager.
2. The fund manager is the only decision maker.

- How may investors have control over the fund manager ?
- How can the information asymmetry between the fund manager and investors be reduced?
  - Agency Problems

The example of dynamic money markets

- The "plausible deniability" hypothesis (Calomiris, 2008) : Estimated subprimes default rate used by the industry = 6%
- We consider a DMM fund described as follows in the information notice :

  "Typical investors are interested in investments consistent with a primary emphasis ***upon preservation of capital*** *while allowing a level of income and total return* ***consistent with prudent investment risk****."*

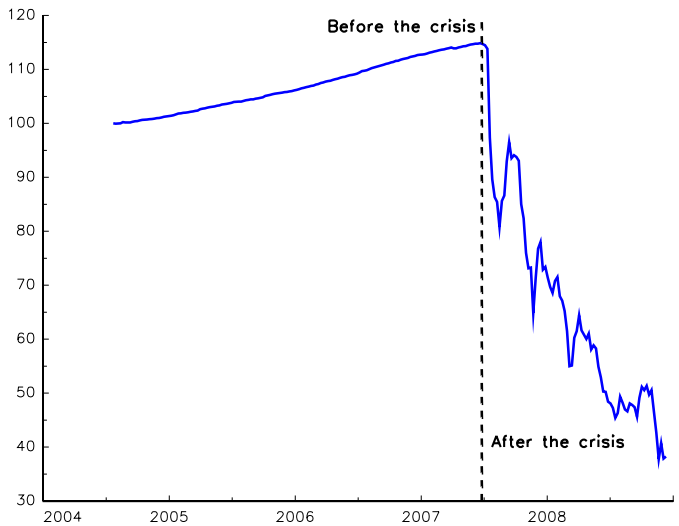


Figure: Performance of the fund

Madoff's returns

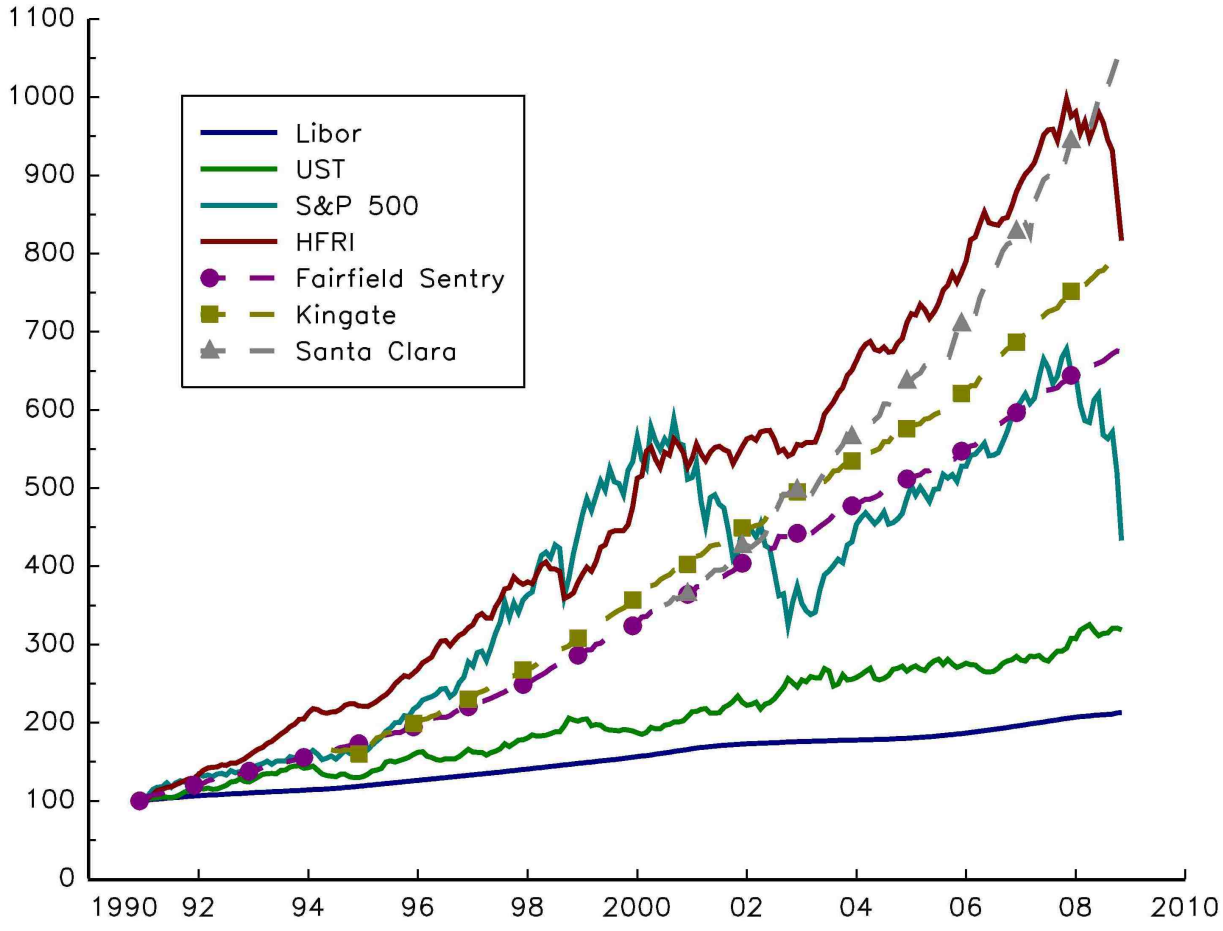


Figure: Comparison of funds invested with Madoff with traditional asset classes

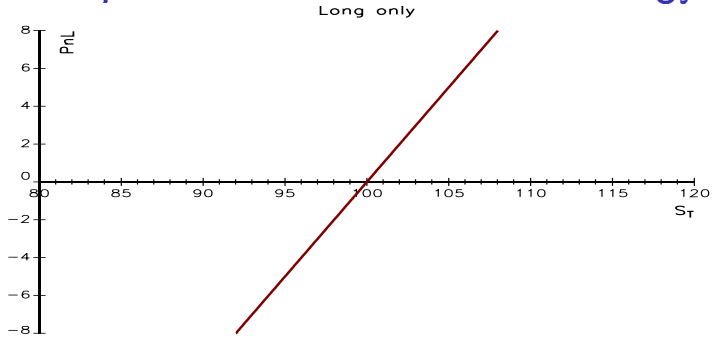
Statistics of funds invested in Madoff 01/1990 – 10/2008

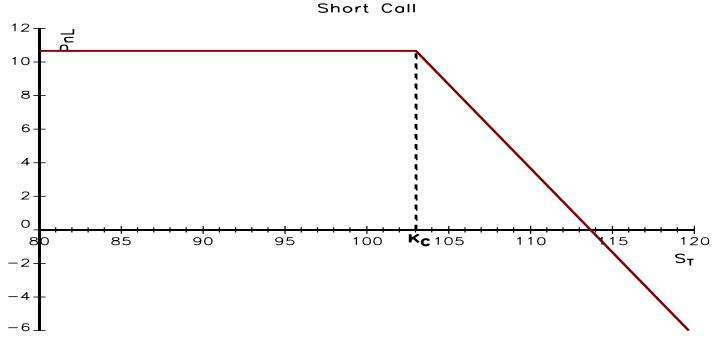
	UST	S&P 500	HFRI	FFS	KING	OPTI	SANTA	LUX	HRLD
$\hat{\mu}_{1Y}$	6.68	8.52	12.42	11.24	11.56	10.96	14.19	8.29	7.27
$\hat{\sigma}_{1Y}$	6.80	14.28	7.08	3.81	4.71	2.69	4.63	1.53	1.69
s	0.33	0.28	1.10	1.75	1.47	2.48	2.26	2.73	1.87
γ_1	-0.32	-0.76	-0.81	4.70	6.14	0.87	1.06	0.48	0.53
γ_2	0.74	1.79	2.99	39.96	59.70	0.27	2.07	0.07	0.24
D_{1M}	-7.09	-16.80	-8.70	-0.55	-2.30	-0.39	-1.87	-0.19	-0.37
D_{3M}	-8.52	-23.11	-13.60	-0.17	-4.53	-0.64	-1.89	0.85	0.56
D_{6M}	-8.83	-29.28	-15.14	0.75	-4.72	0.26	-0.79	2.50	1.85
$D_{\max}$	-10.62	-44.73	-18.13	-0.55	-5.54	-0.64	-2.01	-0.19	-0.37
H	64.65	64.65	73.49	93.37	92.22	91.43	74.75	98.18	88.89

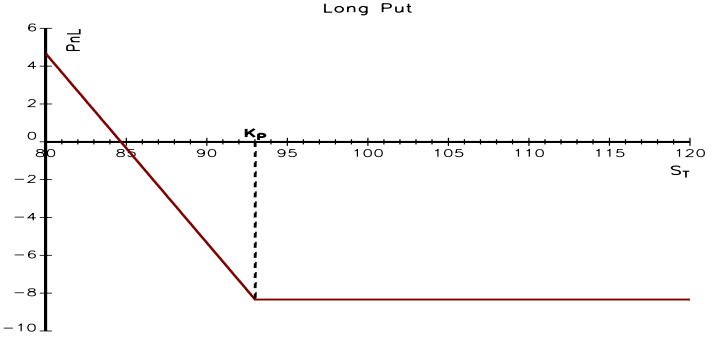
- $\hat{\mu}_{1Y}$: annualized monthly performance,
- $\hat{\sigma}_{1Y}$: yearly volatility,
- s: Sharpe ratio,
- γ_1: skewness,
- γ_2: excess kurtosis,
- D_{1M}, D_{3M} and D_{6M}: resp. 1, 3 and 6 months drawdowns and $D_{\max}$ the maximum drawdown over the entire period.
- H: hit ratio of monthly positive returns.

All statistics are expressed in percents, except for s, γ_1 and γ_2.

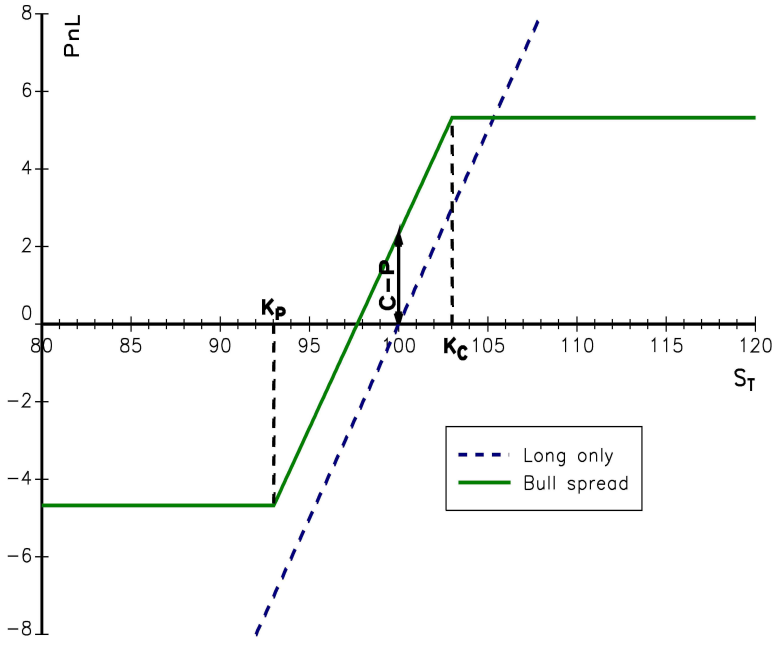
The *Bull-Spread* strategy
a.k.a. *Split-Strike* Conversion Strategy







- *Bull-Spread* strategy
  - a long position on S_t
  - a short position on a call option on S_t, of price $C(K_C)$
  - a long position on a put option on S_t, of price $P(K_P)$
- Payoff function



Rationale for BS strategy

- Higher Sharpe Ratios
  - lower volatility
  - Taking advantage of (left) skew of the distribution of S&P500 returns

- Stock-picking (alpha)

$$\text{PnL}_{[0,T]} = \underbrace{(B_T - B_0)}_{\text{Stock Picking}} + \underbrace{C(K_C) - \max(0, S_T - K_C)}_{\text{Short Call}}$$
$$+ \underbrace{\max(K_P - S_T, 0) - P(K_P)}_{\text{Long Put}}$$

Testing the BS Strategy

Models

Model 1: Geom. Brownian $\quad \mathrm{d}S_t = \mu_S S_t \,\mathrm{d}t + \sigma_S S_t \,\mathrm{d}W_t^S$

Model 2: Skewed $\quad r_S = \ln S_1 - \ln S_0 = \begin{cases} \mu_+ + \sigma_+ \varepsilon & \text{with prob. } p \\ \mu_- + \sigma_- \varepsilon & \text{with prob. } q \end{cases}$

with $\varepsilon \sim \mathcal{N}(0,1)$ and $q = 1 - p$

Model 3: Stock Picking $\quad \mathrm{d}B_t = \mu_B B_t \,\mathrm{d}t + \sigma_B B_t \,\mathrm{d}W_t^B$

with $\left\langle W_t^S, W_t^B \right\rangle = \rho \,\mathrm{d}t$

Simulation Results

		Sharpe Ratio				
		Model 1[a]	Model 2[b]	Model 3		
K_C	K_P			case (1)[c]	case (2)[d]	case (3)[e]
101	99	0.265	0.328	2.319	0.594	0.290
102	98	0.263	0.325	1.795	0.660	0.310
103	97	0.260	0.322	1.481	0.729	0.330
104	96	0.258	0.319	1.276	0.801	0.351
105	95	0.255	0.316	1.132	0.872	0.371
107	93	0.251	0.310	0.947	1.005	0.411
110	90	0.244	0.300	0.792	1.136	0.470
∞	0	0.183	0.183	0.350	0.650	0.650

[a] $\mu_S = 10\%, \sigma_S = \Sigma = 30\%$
[b] $p = \frac{2}{3}, \mu_+ = 21.2\%, \mu_- = -25.9\%, \sigma_+ = \sigma_- = 20.2\%$
[c] $\rho = 1, \mu_B = 15\%, \sigma_B = 30\%$
[d] $\rho = 1, \mu_B = 15\%, \sigma_B = 20\%$
[e] $\rho = 0.85, \mu_B = 15\%, \sigma_B = 20\%$

Main Results

1. The BS Strategy has a higher Sharpe ratio than the long-only strategy ($\times 2$ in the most favorable cases).
2. To obtain a Sharpe ratio larger than one, we need a very good stock picking process :
   - systematic outperformance with respect to the index ;
   - perfect correlation with the index.

Backtesting Madoff's strategy

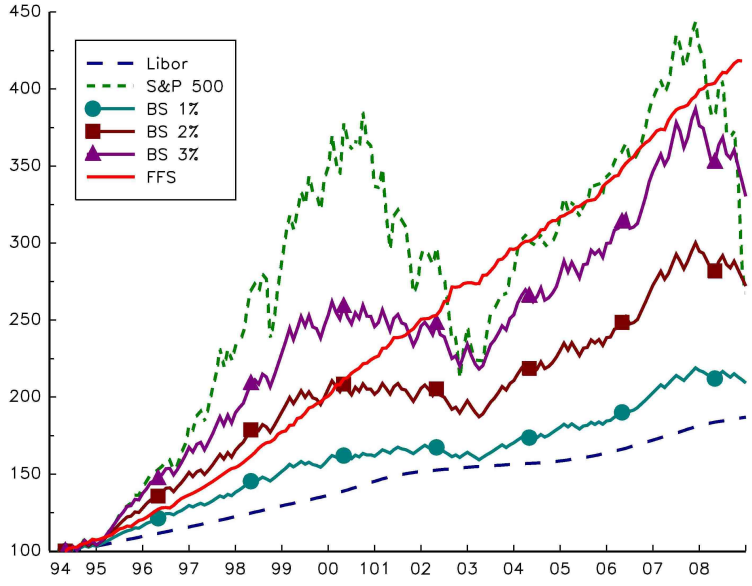


Figure: Backtests of the BS strategy on the S&P500 index

- High Volatility of the backtests
- To match FFS's volatility,
  $\kappa = 0.65\% \rightarrow$ Libor's performance

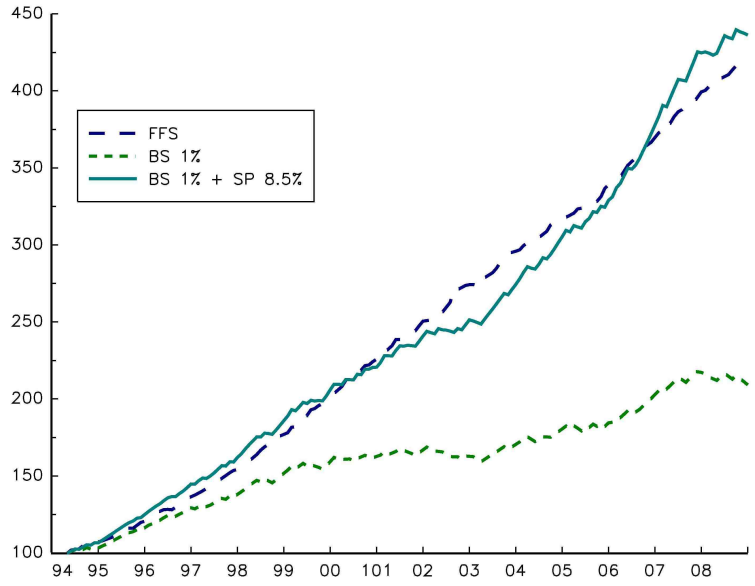


Figure: Introducing stock picking in the BS strategy

- Similar performances, but 30% more volatility.

The Ponzi Model

- K_t: Capital with return r_t
- F_t: Assets Under Management (AUM) with return μ_t
- $K_t^+ = \lambda_t^+ F_t dt$: subscriptions
- $K_t^- = \lambda_t^- F_t dt$: redemptions
- m_t: management fees

- Ponzi scheme described by

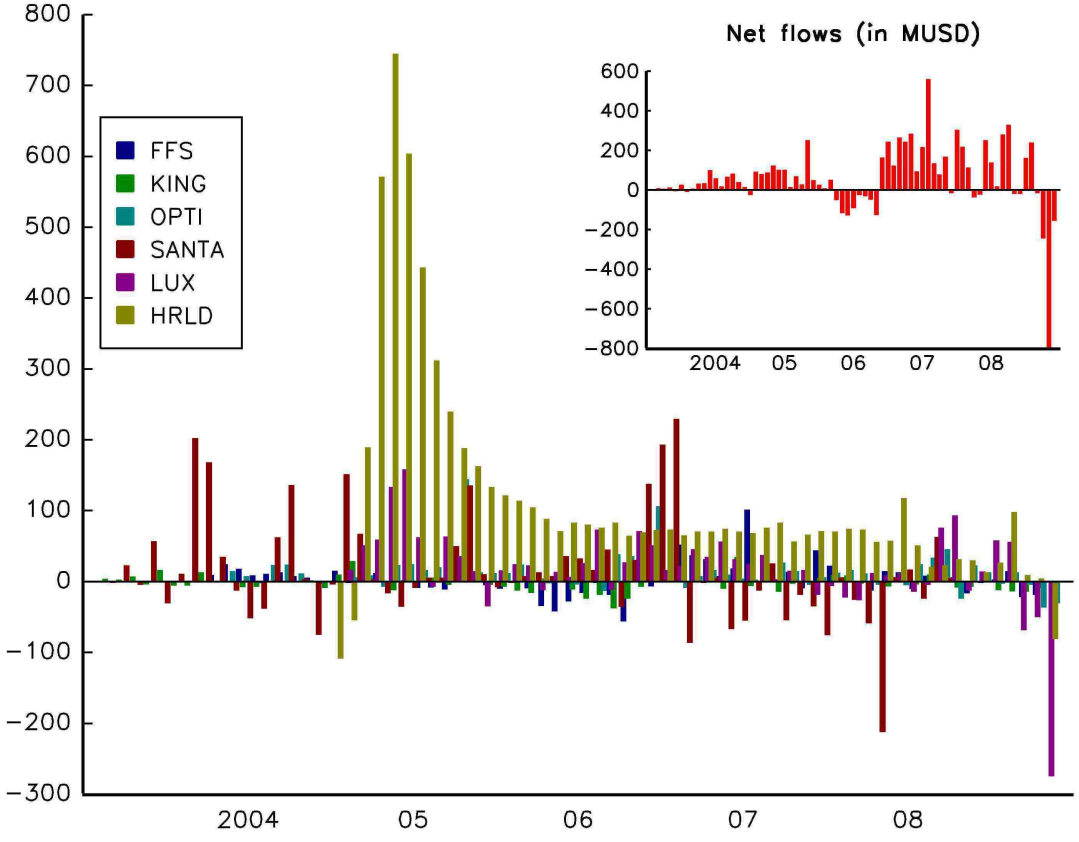
$$\begin{cases} dK_t &= r_t K_t \, dt + \left(\lambda_t^+ - \lambda_t^-\right) F_t \, dt - m_t F_t \, dt \\ dF_t &= \left(\mu_t - m_t\right) F_t \, dt + \left(\lambda_t^+ - \lambda_t^-\right) F_t \, dt \end{cases}$$

with $K_0 = F_0$

Main Findings

- Management fees are the main contributors to capital shrinkage.
- Default may be avoided only if $m_t < \lambda_t^+ - \lambda_t^-$.
- Default time is a negative function of m_t and μ_t.
  - Higher fees
    $\rightsquigarrow$ more capital used to remunerate the fund manager
  - Similarly, high μ_t
    $\rightsquigarrow$ AUM grow more quickly and more fees are generated.

Estimating net flows rates and amounts



6 feeder funds

- Fairfield Sentry Ltd (FFS);
- Kingate Global Fund Ltd (KING);
- Optimal Strategic US Equity Ltd (OPTI);
- Santa Clara I Fund (SANTA);
- LuxAlpha Sicav (LUX);
- Herald Fund SPC (HRLD).

Figure: Net flow rates (large graph) and Monthly net flow amounts (top-right graph)

Explaining the collapse of Madoff
Main contributor: LuxAlpha Sicav

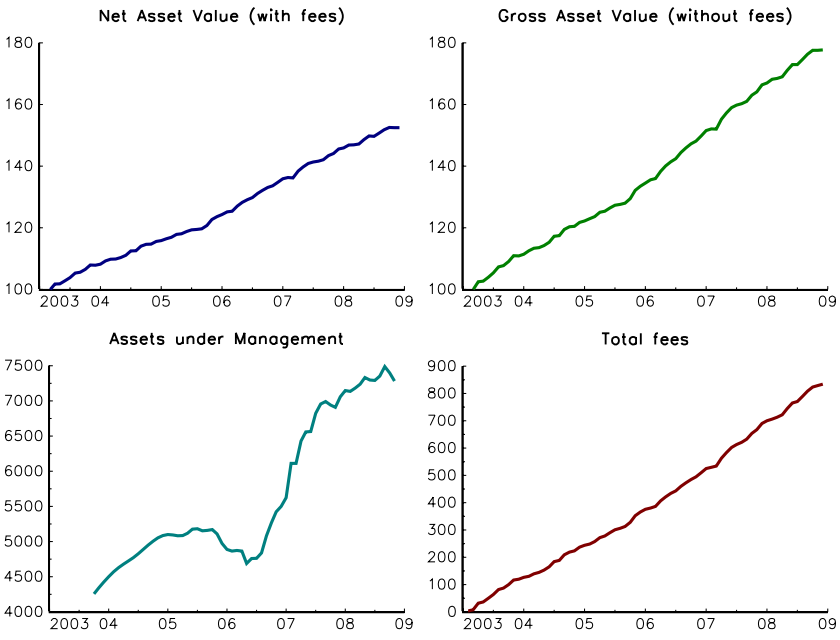


Figure: An example of fees computing

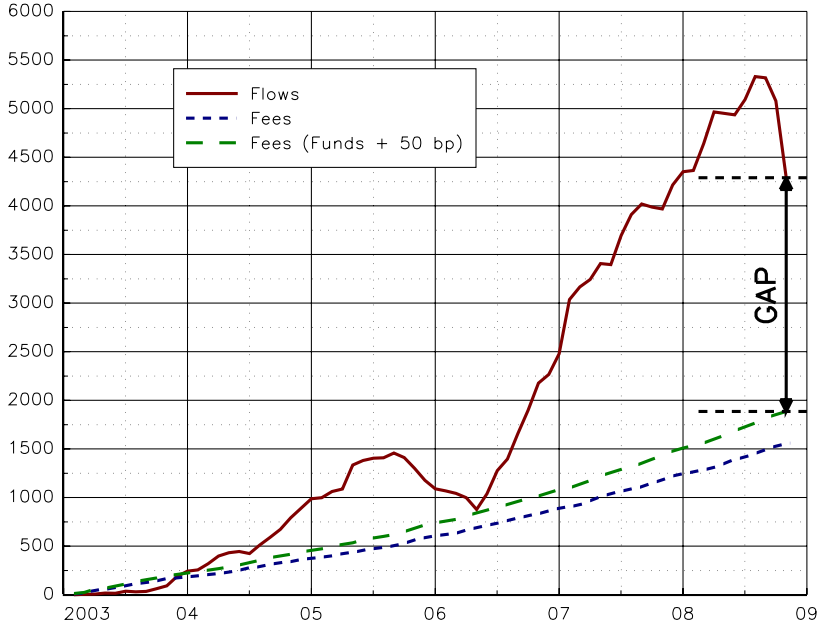


Figure: Estimating the gap in October and November 2008

Characterization of Madoff's fraud

- For the financial institutions that have launched or distributed Madoff's feeder funds or related products, Madoff's fraud is
  - an internal fraud
  - an external fraud
  - the risk type Clients, Products & Business Practices: *"Losses arising from an unintentional or negligent failure to meet a professional obligation to specific clients (including fiduciary and suitability requirements), or from the nature or design of a product."*
- Frauds of this extent are unprecedented for the asset management industry $\Longrightarrow$ What is the impact on operational risk requirements ?
  - A new beta in the Standardized Approach ?
  - Impact on Advanced Measurement Approach (AMA)

Definition

Capital Charge $= \beta \times$ Gross Income

Example

For a gross income of US$ 1 billion, the yearly capital charge for operational risk is US$ 120 millions.

Table: The SA approach in Basel II

Business Line	β factor
Corporate finance	18%
Trading and sales	18%
Retail banking	12%
Commercial banking	15%
Payment and settlement	18%
Agency services	15%
Asset management	12%
Retail brokerage	12%

LDCE 2008

- Asset Management represents 4% of consolidated gross income (7.7% for Trading & Sales).
- Asset Management losses represent 2.5% of total losses (13.6% for Trading & Sales).
- Annual frequency = 704 losses per year larger than 20000 euros (74% for the risk type Execution, Delivery, and Process Management and 14% for the risk type Clients, Products & Business Practices).
- Annual loss amount = 242.9 ME (53% for the risk type Execution, Delivery, and Process Management and 31% for the risk type Clients, Products & Business Practices).
- The 95th percentile of individual losses is 620000 euros.

$\Longrightarrow$ What would be the impact of Madoff's Fraud ?

Impact of a large loss

- Loss Distribution Approach (LDA)

$$L = \sum_{n=0}^{N} \ell_n$$

where :

- L is the annual operational risk loss,
- N is the number of next year losses (frequency distribution),
- ℓ_n are the individual losses (severity distribution).

- The Capital Charge is defined by the 99.9% percentile of L.
- a large loss $\Longrightarrow$ great impact on the severity distribution particularly for low frequency risk type.
- Asset Management (in France) could not support losses greater than 30 ME.

Rethinking Due Diligence Processes

- 4 of the 10 biggest FOHF managers have invested in Madoff's funds.
- Madoff was on the black lists of several banks.
- Operational due diligence versus Quantitative due diligence $\Longrightarrow$ lack of quantitative expertise.
- Initiatives to define a common analysis framework: AIMA, HFWG, etc.

One solution

Product-oriented regulation $\Longrightarrow$ Actor-oriented regulation (the importance of responsibility).

Rethinking the Hedge Fund industry

- 2003-2007: HF bubble (like the internet bubble).
- 2008-2009: *Annus horribilis* (liquidity, gates, Madoff, Wearing Capital, K1).
- "Retailization" of the industry.
- Diabolization of the hedge fund industry.

- Promote transparency, liquidity and standardization
  - Platform of managed accounts.
  - Replication products (carry trades, volatility selling, etc.).
  - Benchmark (investable indices) $\Longrightarrow$ first step to build a regulation on hedge funds.

Impact on Regulations

- The case of LuxAlpha Sicav $\Longrightarrow$ problem of coordination?
- Completing the UCITS III framework ?

Our thinking

- Keep things very clear for investors.
- A part of the HF industry wants to be regulated.
  - Need a specified format and regulation for these hedge funds.
  - Create incentives.
- AIFM directive $\Longrightarrow$ Right answer ?

The AIFM Directive

- Good things
  - Regulates unregulated investment products
  - Proposes a set of rules (valuation, custody, etc.)
  - Systemic risk vs investors protection
- Two main problems
  - Wide scope of non UCITS investment vehicles (Private Equity, Hedge Funds, Real-Estate, National regulated funds)
    - Very differents in terms of investors, strategies, risks, etc.
    - The specific case of private equity (+ Solvency II).
    - Too much large and general !
  - Ressources and competencies to regulate the industry.

For Further Reading I


Carole Bernard, Phelim Boyle.
Mr. Madoff's Amazing Returns: An Analysis of the Split-Strike Conversion strategy.
Working Paper, 2009.


Charles W. Calomiris.
The Subprime Turmoil: What's Old, What's New, and What's Next.
Working paper presented at the IMF Ninth Jacques Polak Annual Research Conference, October 2008.


Pierre Clauss, Thierry Roncalli, Guillaume Weisang.
Risk Management Lessons From Madoff Fraud.
forthcoming in *International Finance Review*, available on SSRN, 2009.