

# Risk Management for Hedge Fund Portfolios



**Partners Group**  
Passion for Alternative Investments

## **Risk Management for Hedge Fund Portfolios**

**Presentation at ETHZ**

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# Table of content

## I. Introduction to Hedge Fund Risk Management

## II. Appropriate risk measures for hedge fund strategies

## III. Risk Management in practice



**“Passion delivers transparent solutions”**



# Hedge Funds – Comparison to traditional asset classes

3

<b>Investment Class</b>	<b>Hedge Funds</b>	<b>Traditional Investments</b>
<b>Strategies</b>	<b>Long &amp; Short</b>	<b>Long Only</b>
<b>Performance Measurement</b>	<b>Absolute</b>	<b>Benchmark</b>
<b>Positive Returns</b>	<b>Independent of Behavior of Traditional Markets</b>	<b>Conditional on Rising Markets</b>
<b>Technique</b>	<b>Leverage / Deleverage</b>	<b>Limited Use of Leverage / Deleverage</b>
<b>Manager's Own Investment</b>	<b>Invested</b>	<b>Not Invested</b>
<b>Risk</b>	<b>Absolute Risk</b>	<b>Tracking Error</b>
<b>Fees</b>	<b>Management and Incentive fee</b>	<b>Management Fee Only</b>
<b>Transparency</b>	<b>Often still very low</b>	<b>Public information distribution</b>
<b>Correlation between manager</b>	<b>Low</b>	<b>High</b>



# Different hedge fund risks and approaches to manage them

## Market related risk (style risks)

- Equities
- Interest rates
- Commodities
- FX
- Credit
- Liquidity
- Volatility



Systematic  
Returns

Strategy Sector  
Diversification

## Manager related risk

- Operational risk
- Model risk
- Leverage
- Style drifts
- Fraud
- “Blow up”
- Low diversification



Non Systematic  
Returns

Control and Active  
Risk management



## Risks hedge funds share with other investment classes

**Market Risk:** risk of loss due to unexpected and adverse price moves or changes of volatility in the broad markets or single sectors.

**Credit Risk:** risk of counter-parties defaulting on their obligations or of changes in the market's sentiment about the probability of their default.

**Liquidity Risk:** 1. The risk of loss due to the (temporary) inability to unwind a position at a normal bid/ask spread; 2. The risk of not being able to fund investment leverage.

**Common Factor Risk:** risk inherent in some, but not all, securities (e.g. industry specific).

**Operational Risk:** risk of failure of internal systems, technology, people, external systems, or physical events.

**Event Risk:** risk of an extraordinary event, e.g. unexpected election outcome, military events, sovereign default.

**Corporate Event Risk:** risk of loss due to an exposure to a particular firm and a specific event affecting its value, e.g. surprise announcements like earnings revisions, mergers or changes of management .

**Model Risk:** risk of a model mis-specification

*Important to consider:* (Complex) relationship between market risk, manager risk, liquidity risk, counterparty risk, pricing risk, and leverage (the complexity is often characteristic for hedge funds)

## Risks more specific to hedge funds

**Lack of Transparency** : Lack of transparency and insufficient investor control are the main reasons for the high level of idiosyncratic manager risk.

**Manager (idiosyncratic) Risk**: much discretionary decision-making power is concentrated in one or a few individuals, e.g. style drift.

**Leverage Risk**: two components: Volatility and financing (in combination with counterparty risk).

**Capacity Risk**: potential capacity limits of the strategy

**Fraud Risk**: manager defrauding investors

**Valuation Risk**: pricing and NAV calculation for investment funds is not guided by unique standards

**Concentration Risk**: size of individual positions

**Regulatory Risk**: Changing regulatory or tax requirements



# First example: Leveraged Fixed Income Arbitrage

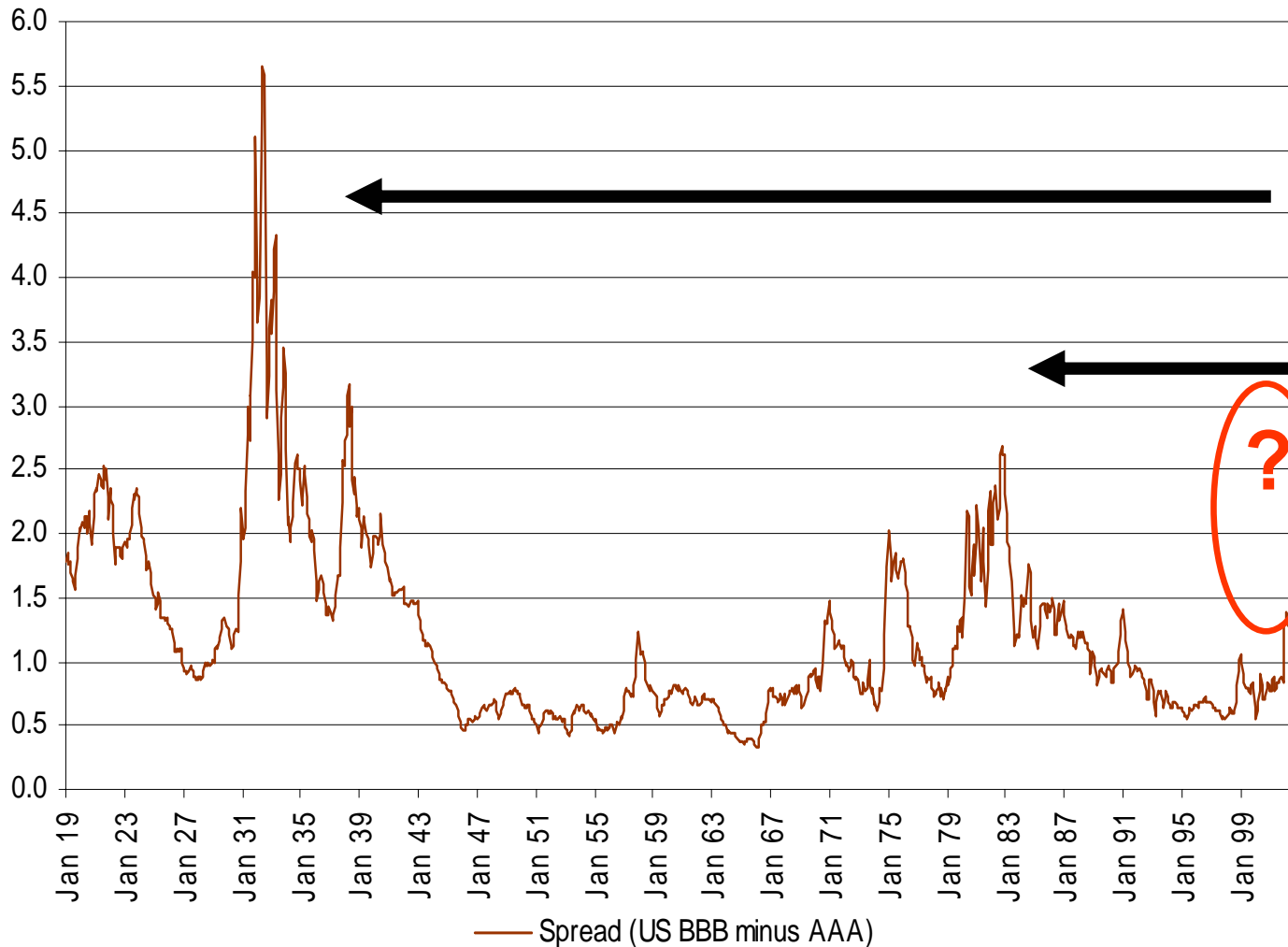
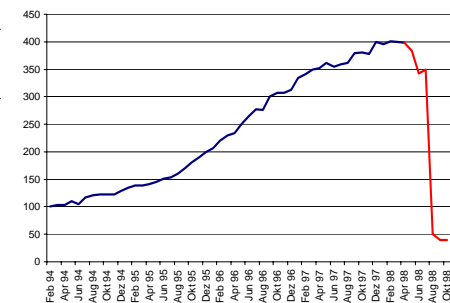
**Fixed Income (FI)  
Arbitrage Regression  
analysis\*:**

**A sudden rise in  
credit spreads of  
+1% results in a  
negative return  
of - 8%!**

**Historical returns  
of FI Arbitrage:**

- 1931: - 24%**
- 1970: - 10%**
- 1974: - 14%**
- 1979: - 7%**
- 1980: - 9%**

**LTCM**



\*Fung/Hsieh, The Risk in Hedge Fund Strategies: Theory and Evidence from Fixed Income Traders, October 2001



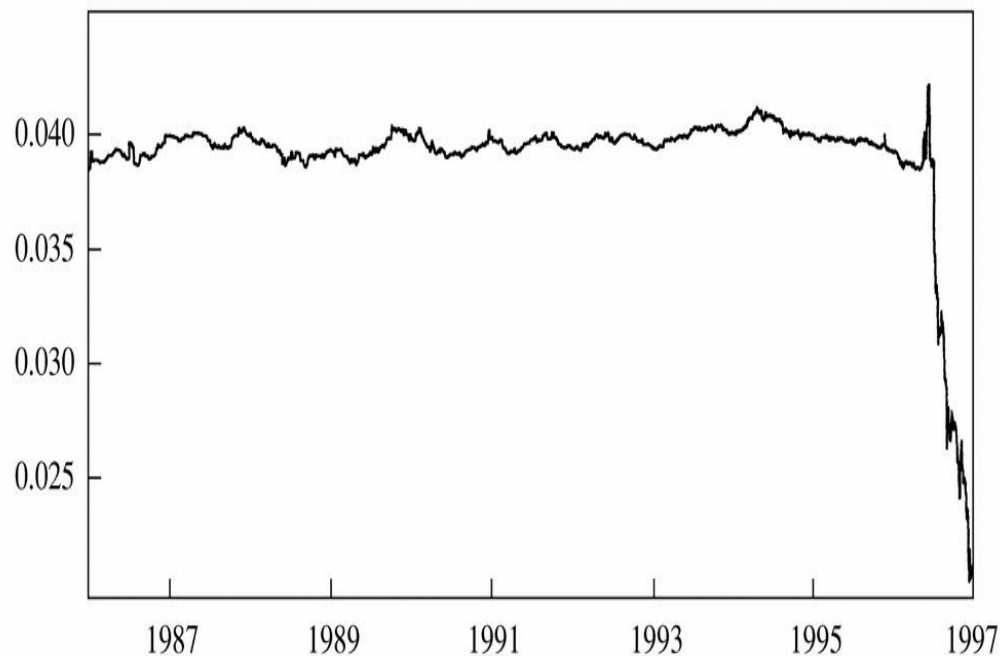
## Second example: Leveraged FX Arbitrage (Carry Trades)

8

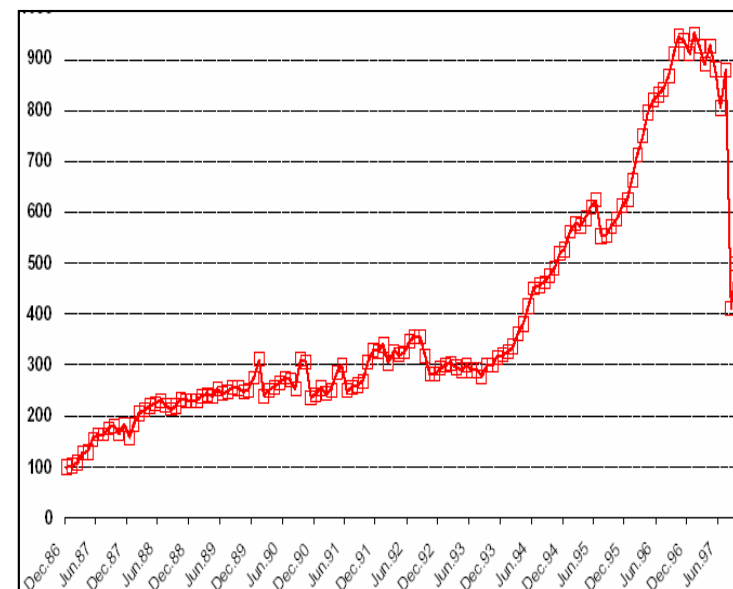
→ e.g. Borrow US\$ at 6% p.a. and invest in Thai Baht at 12% p.a. with leverage

### NAV Niederhoffer Fund

U.S. dollars per baht



Source: Datastream.





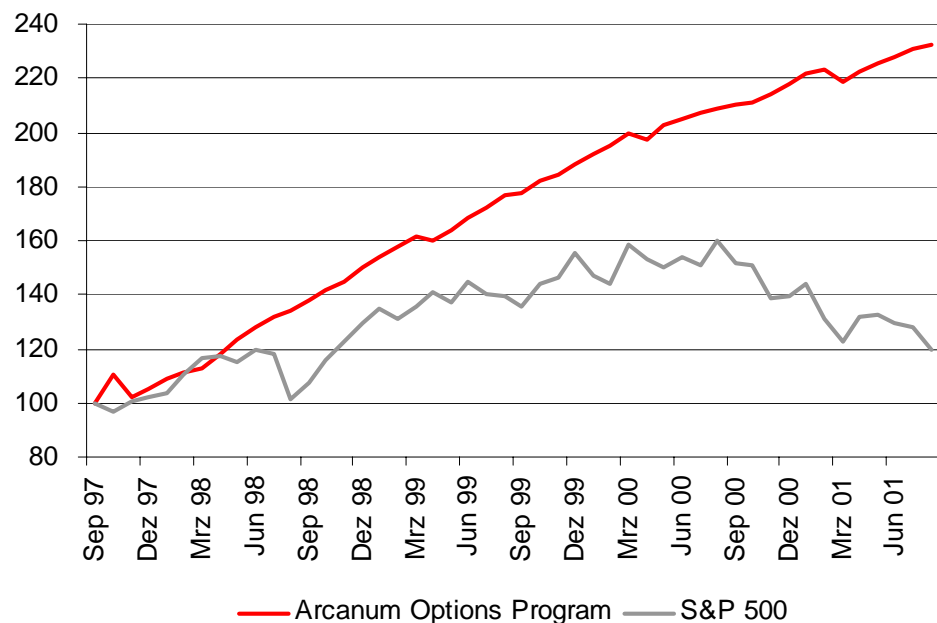


## Third example Leveraged Option Writing

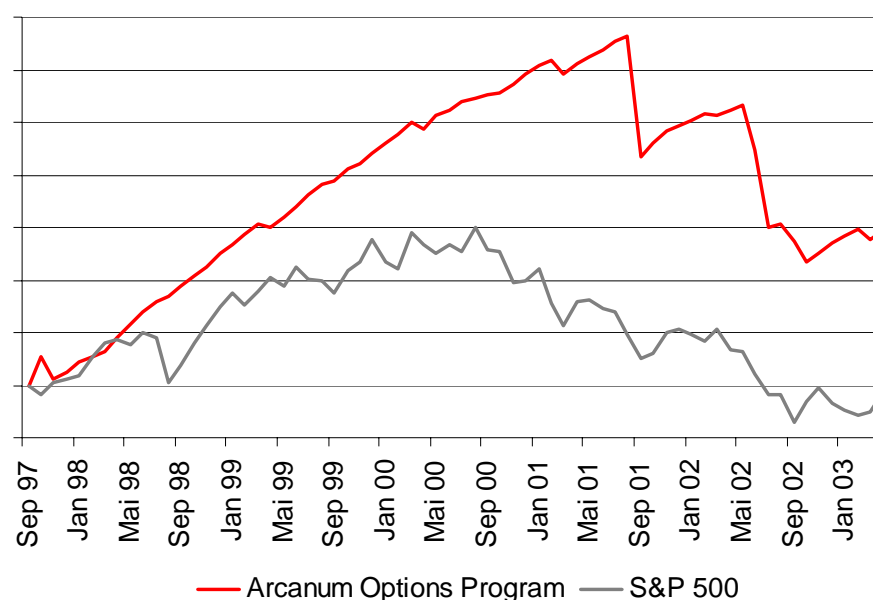
9

**High probability to make 2-4% each month and small probability to loose -25% in one particular month! Strategy: Sell out-of-the money options with leverage.**

**Oktober 1997 – Juni 2001**



**Oktober 1997 – April 2003**



### Conclusion:

**Too smooth performance streams can include toxic blow-up risk!**

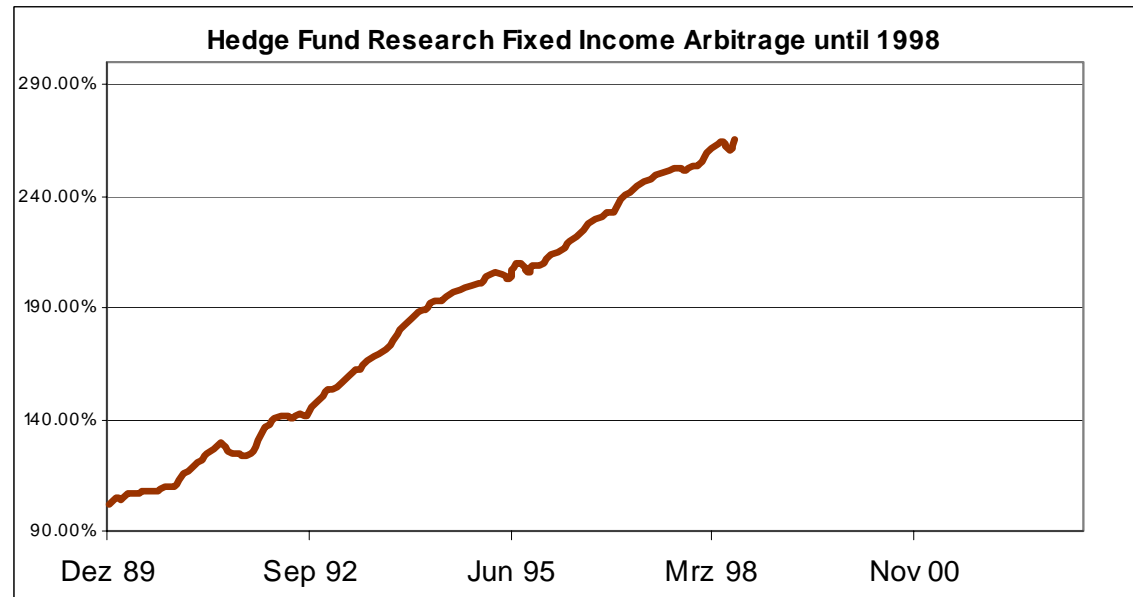


# Hedge Funds Risks: One more example

Fixed Income Arbitrage before 1998:

Return: 12.29% p.a.  
Volatility : 3.83%

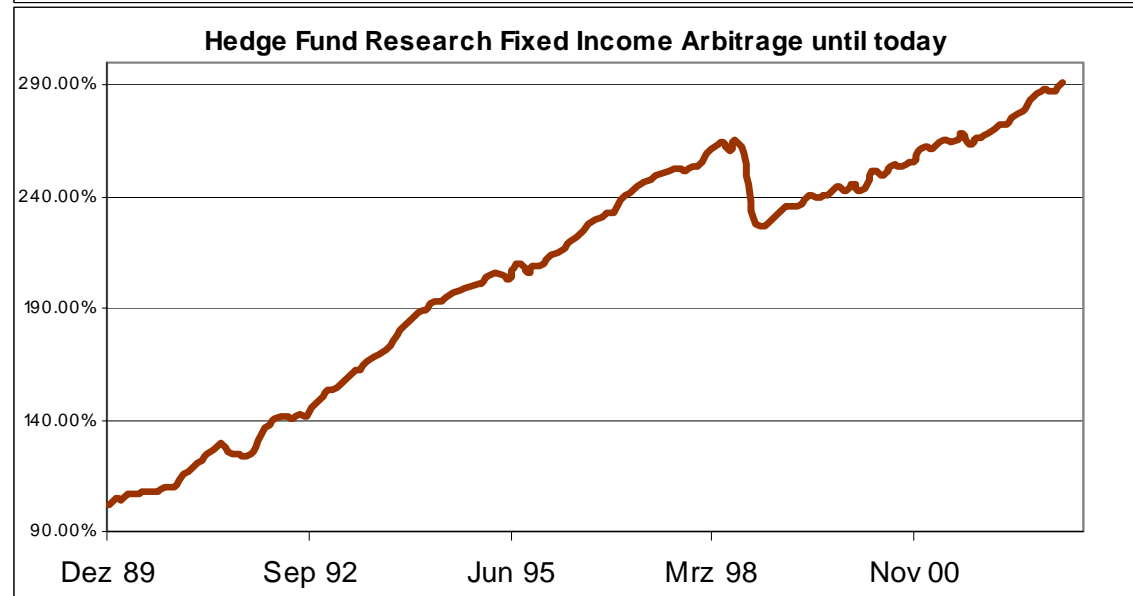
Sharpe Ratio: 1.9



Fixed Income Arbitrage until today:

Return : 8.58% p.a.  
Volatility : 4.64%

Sharpe Ratio: 0.75



Source: HFR, Calculation: Partners Group



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**“Passion delivers transparent solutions”**



# Hedge Funds Risks: Beyond the normal distribution I

## Box-Plots for the returns of different Hedge Fund strategies in comparison to the Normal distribution

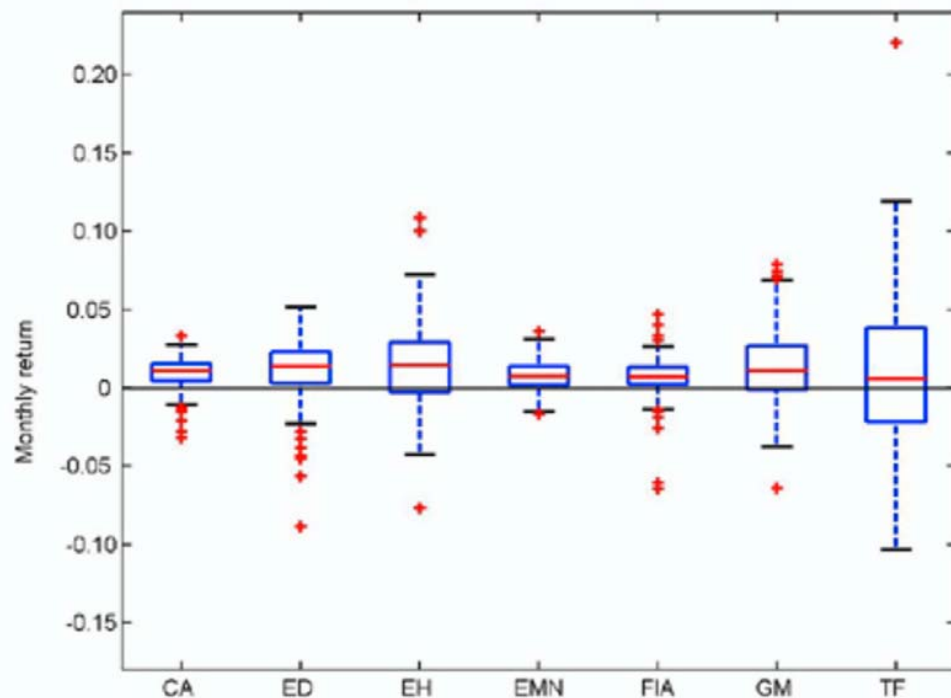


Figure 3.1: Boxplots of the Hedge Fund monthly return data

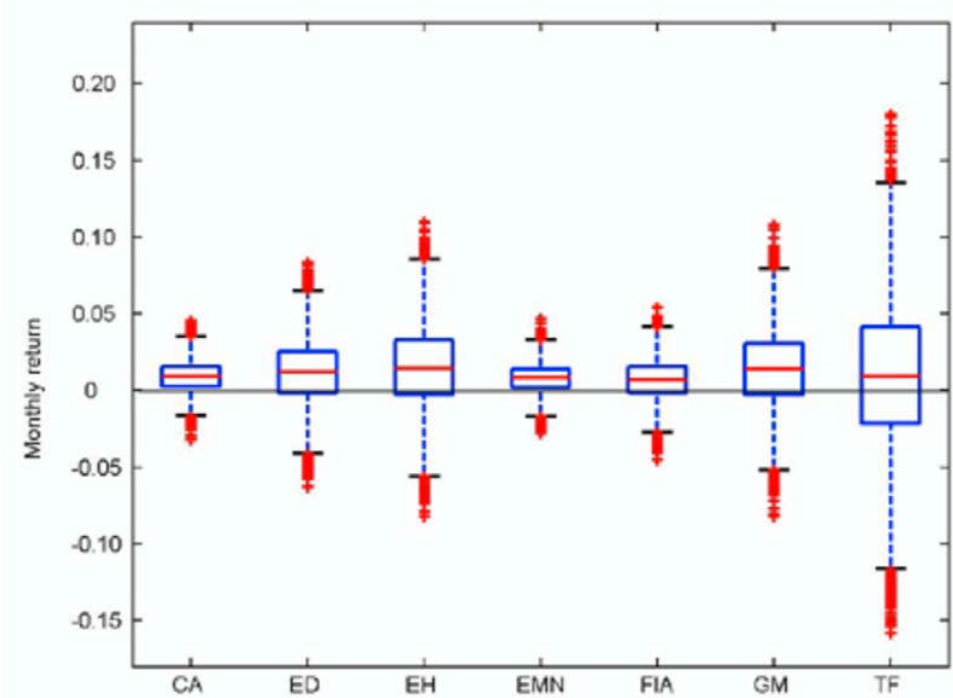


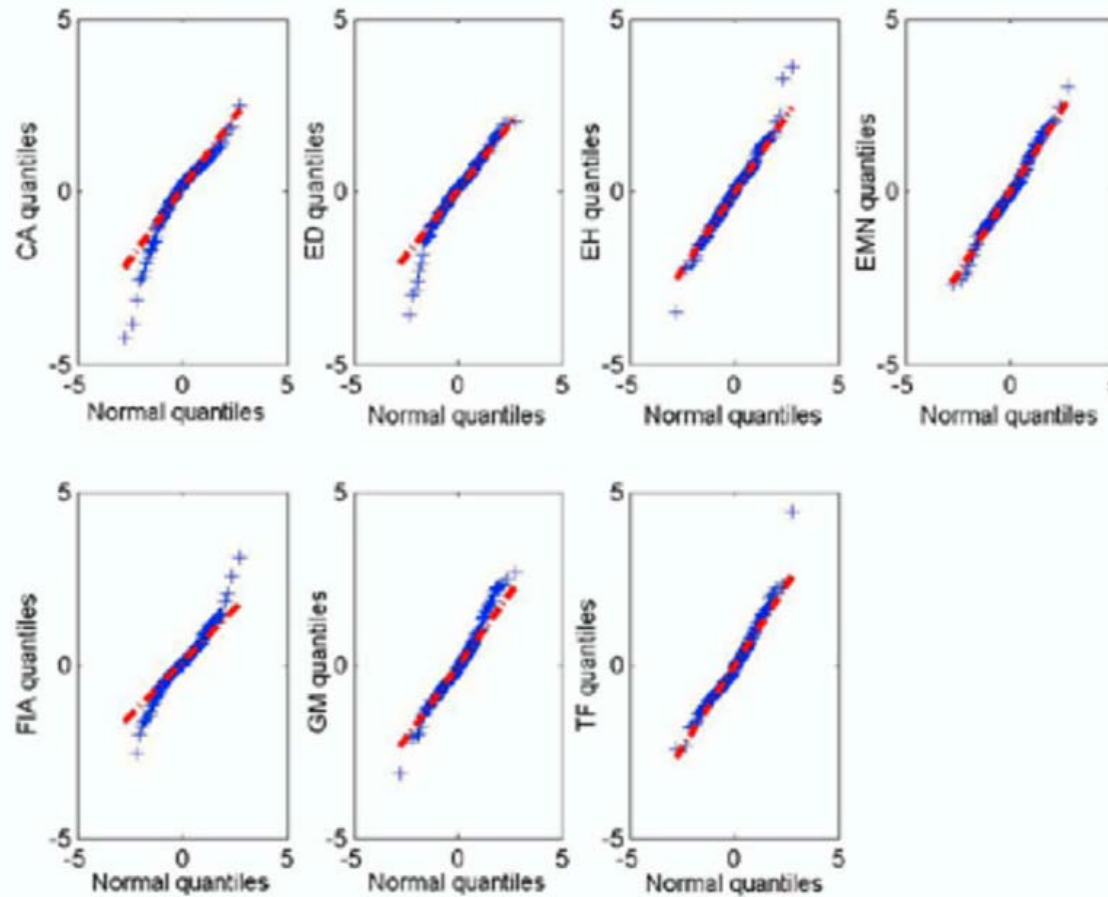
Figure 3.2: Boxplots of data sets of 10.000 points which were derived from the normal distribution with mean and standard deviation of the Hedge Fund strategies' monthly return data

Data: HFR, SISDM; Jan. 1990-Sept. 2004. CA: Convertible Arbitrage, ED: Event Driven, EH: Equity Hedge, EMN: Equity Market Neutral, FIA: Fixed Income Arbitrage, GM: Global Macro, TF: CISDM Trend Follower Index.



# Hedge Funds Risks: Beyond the normal distribution II

QQ-Plots of the quantiles of the empirical hedge fund return distributions with respect to the normal distribution



Data: HFR, SISDM; Jan. 1990-Sept. 2004. CA: Convertible Arbitrage, ED: Event Driven, EH: Equity Hedge, EMN: Equity Market Neutral, FIA: Fixed Income Arbitrage, GM: Global Macro, TF: CISDM Trend Follower Index.

Figure 3.3: QQ plots of standardized Hedge Fund strategy return quantiles vs standard normal quantiles



# Hedge Funds Risks: Beyond the normal distribution III

## Risiko-Rendite-Charakteristika der Relative Value-Strategien inklusive höherer Momente

	Return	Volatility	Max. Drawdown	Sharpe Ratio	Skew	Kurtosis
<b>Event-Driven</b>						
HFR	13.89%	6.69%	-10.78%	1.33	-1.51	5.62
Tremont	10.81%	6.07%	-16.05%	0.96	-3.84	27.16
<b>Relative Value</b>						
Convertible Arbitrage (HFR)	10.69%	3.38%	-4.84%	1.68	-1.27	2.82
Convertible Arbitrage (Tremont)	9.74%	4.75%	-12.03%	1.00	-1.60	4.20
Fixed Income Arbitrage (HFR)	8.24%	4.44%	-14.42%	0.73	-1.87	10.65
Fixed Income Arbitrage (Tremont)	6.68%	3.95%	-12.48%	0.43	-3.41	18.20

Data: HFR; Jan. 1990-Sept. 2004



## State-of-the-art risk analysis

15

### Can be equally applied to hedge funds

#### ➤ Exposure analysis

- Breakdown of the exposure of the portfolio to different assets (risk factors)
- Monitoring margin characteristics and leverage factors for individual managers

#### ➤ Value at risk (VaR)

- Global portfolio at specified confidence intervals and time horizons
- Drilldown of VaR to single managers and asset classes
- VaR tracking (VaR evolution over time)
- Incremental (and marginal) VaR calculations for individual asset classes/positions
- Shortfall probability (Conditional VaR)

#### ➤ Beyond VaR

- Analysis of Stress tests
- Scenario analysis



## Value at Risk

### **The most widely used measurement tool for risk analysis**

- Describes the maximal loss from an adverse market move within a specified confidence level over a specified trading horizon (e.g. 1 day or 5 day)
- Characterizes the extreme quantile on a return distribution mostly assumed to be normally distributed (central limit theorem)
- With VaR risk can be quantified across different instrument and asset classes where correlation as well as volatilities are fully accounted for using a uniform and comparable measuring system for risk.
- Confidence interval employed: 95%, 99% (BIS requirement), and 99.6 %
- Trading horizon: One day, ten days (BIS requirement)



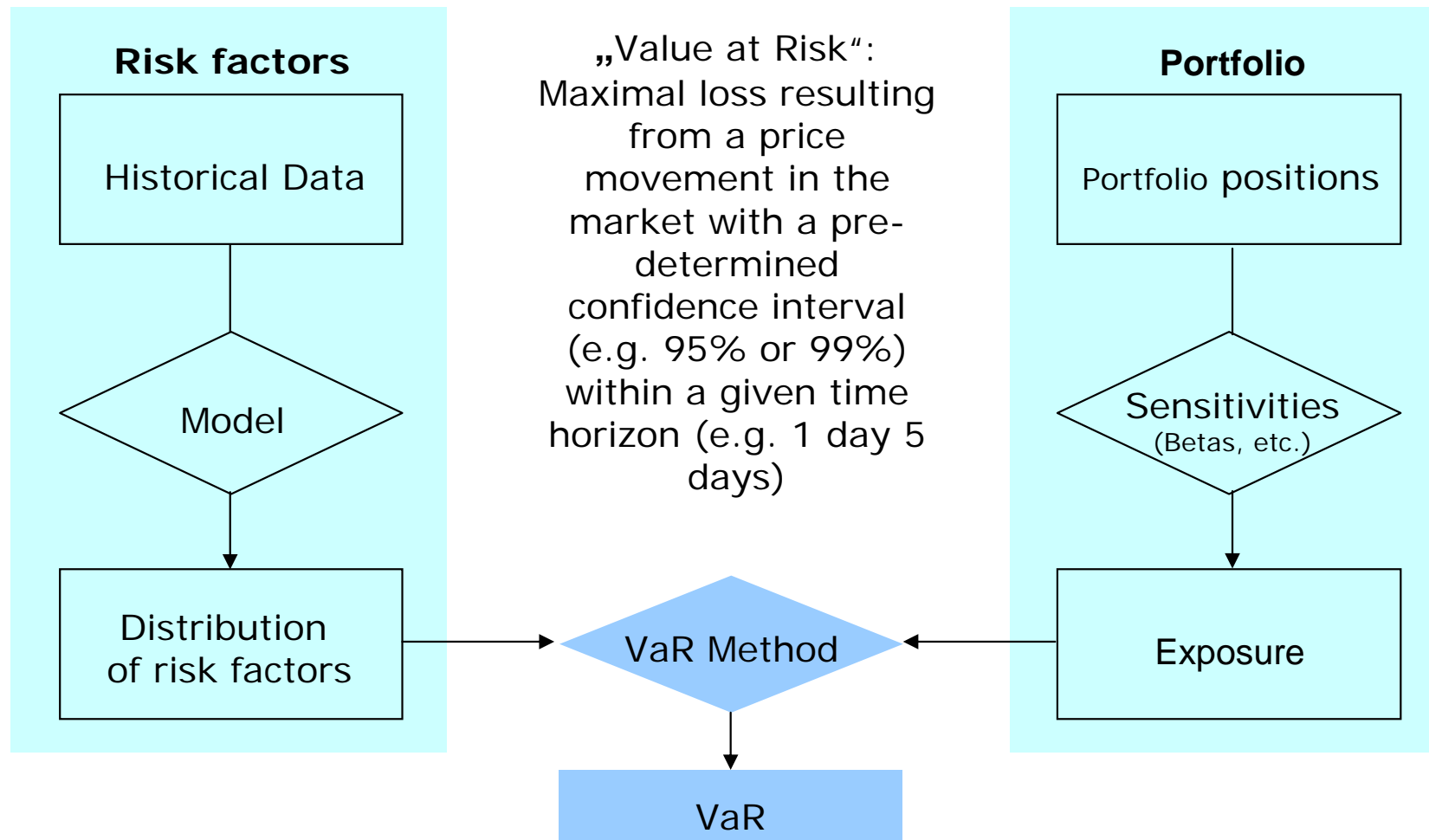


## Value at Risk

- Measures the maximal expected loss for a given time period within the specified confidence interval
- Analysis of a large amount of possible risk factors in the portfolio:  
The number of risk factors can be quite large (>1000): e.g. yield and spread curve, commodity term structure, equity indices, currencies.
- Should be calculated on a variety of different aggregation levels (“VaR drilldown”)
  - asset classes
  - sector and instrument
  - manager
  - geographical location
- Three different methods:
  - Variance-based
  - Monte Carlo
  - Historical simulation

Monte Carlo simulation is most reliable for the nonlinear and complex positions present in most hedge fund portfolios.

# Value at Risk (VaR) II





## VaR calculates with different methods

Value-at-Risk (one day), calculated with the empirical distribution and the assumption of a normal distribution

	VaR 99% (Gauss)	VaR 99% (Empirical)	VaR 99.6% (Gauss)	VaR 99.6% (Empirical)
MSCI World Sovereign Index	-0.85%	-0.90%	-0.97%	-1.10%
Foreign Exchange (USD/GBP)	-1.21%	-1.37%	-1.38%	-1.78%
Daily Hedge Fund Index	-1.71%	-1.95%	-1.96%	-2.41%
Dow Jones Industrial	-2.48%	-2.92%	-2.83%	-3.76%
Brazilian Stock Index	-6.59%	-7.85%	-7.56%	-10.13%

Source: „Performance and risk measurement challenges for hedge funds: empirical considerations“, by P. Blum, M. Dacorogna, L. Jaeger , in L. Jaeger (ed.) “The New generation of risk management for hedge funds and private equity investments”, Euromoney (2003)



## The Limitations of VaR

- It does not provide any information about the extreme left tail of the profit and loss (P&L) distribution and the expected size of an experienced loss that exceeds VaR (insufficient description of the left tail of the distribution).
- VaR relies heavily on its particular assumptions on about the probability distribution of extreme returns/assumption of normality of the returns.
- VaR relies on estimates of correlations and volatilities. Especially in times of crisis, these assumptions become invalid
- VaR only captures certain systematic risk factors, such as market (equity, bond, FX, commodity) or credit risk. Non-systematic risk (idiosyncratic, e.g. corporate event, risk, liquidity risk, credit spread risk, operational risk, political risk, model risk). With a generally higher degree of non-systematic risk in their portfolios, VaR is less likely to provide a reliable approximation of total risk in hedge funds.
- VaR has an important and widely criticized theoretical shortcoming: It is not additive with respect to sub-portfolios. Thus, VaR does not qualify as a “coherent risk measure”.



## Beyond VaR

- **Marginal and Incremental VaR:** amount by which the value of VaR is increased upon inclusion of a particular position or sub-portfolio.
- **Expected Shortfall (Conditional VaR):** mean value of the portfolio loss, conditional on the loss exceeding a certain threshold given by the VaR
- **Lower partial moments (LPM):** A set of lower partial moments can be defined by the n-th power of the loss exceeding a certain threshold:

$$\text{LPM}(n) = E[(\text{return} - \text{threshold})^n] \text{ for return} < \text{threshold}$$

For  $n=1$  this measure reduces to the Conditional VaR. For  $n=2$  and the threshold equal the expected return, this measure reduces to the semi-variance, i.e. the variance with only returns below the expected return taken into account (the square root of which is often referred to as "downside deviation").

- **Stress Tests**
- **Extreme Value Theory:**
  - Non-normal distributions for tails (GPD)
  - Generalized dependency structures (copula functions)



## Hedge Fund risk as measured by different tools

Empirical estimation of various risk measures for a set of financial instruments. The estimation is based on the logarithmic returns of 10 years of daily prices (1.1.1993 – 31.12.2002) (sample information). The data is ordered by increasing volatility (standard deviation).

	Standard Deviation	VaR(99%)	ES(98.75%)	VaR(99.6%)	ES(99%)
MSCI World Sovereign Index	0.37%	-0.90%	-1.08%	-1.10%	-1.27%
Foreign Exchange (USD/GBP)	0.52%	-1.37%	-1.66%	-1.78%	-1.75%
Daily Hedge Fund Index	0.77%	-1.95%	-2.32%	-2.41%	-2.44%
Dow Jones Industrial	1.08%	-2.92%	-3.77%	-3.76%	-4.04%
Brazilian Stock Index	2.96%	-7.85%	-9.59%	-10.13%	-10.20%



## Complement the calculation of VaR – Stress tests

- Use extreme stress scenarios in order to ascertain coverage of extreme markets; apply pre-determined price changes to the positions
- Show how the portfolio behaves under extreme, but plausible market conditions
- Three different groups of scenarios underlying stress tests:
  - Historical scenarios (e.g. the stock market crash of 1987)
  - Market scenarios (e.g. a drop of 15 % in the equity markets)
  - Portfolio specific scenarios (e.g. for credit sensitive portfolios)
- Systematic stress testing for market risk includes the following:
  - Test asymmetries
  - Correlation breakdown
  - Stressing different combinations of asset classes separately and combined
  - Appropriate size shocks
- Scenarios on equities, interest rate (yield curve shape), FY rates, commodities, stock and bond volatility and past event.



## A short excursion into (univariate) Extreme Value Theory (EVT) - I

Instead of investigating the tail of the return distribution  $F(x)$  itself, one can also investigate the excess distribution of the return variable  $X$  above the threshold  $u$ . This is the conditional distribution of  $X-u$  given that  $X$  is greater than  $u$ , i.e.

$$F_u(y) = \Pr(X - u \leq y \mid X > u)$$

The original distribution  $F(x)$  for  $x \geq u$  can then be recovered via:

$$F(x) = (1 - F(u))F_u(x - u) + F(u)$$

A main theorem of EVT states that, for some reasonably high threshold,  $u$ ,  $F_u(y)$  can be approximated to deliberate accuracy by the *Generalized Pareto Distribution (GPD)*, which is defined as:

$$G_{\xi, \beta}(y) = \begin{cases} 1 - (1 + \xi y / \beta)^{-1/\xi} & | \xi \neq 0 \\ 1 - \exp(-x / \beta) & | \xi = 0 \end{cases}$$

While  $b > 0$  is a mere scale parameter,  $\xi$  governs the shape of the distribution. Tail analysis essentially boils down to estimating the shape parameter  $\xi$ .





## A short excursion into (univariate) Extreme Value Theory (EVT) - II

Easy though it may look, practical tail estimation suffers from a number of problems:

- Selection of a reasonable threshold  $u$ , on which the estimated tail index is often heavily dependent.
- Amount of data available in the tail is often very low, leading to broad confidence intervals and only weakly significant estimates. This problem applies particularly to the realm of hedge funds.

Practical tail estimation is therefore rarely a straightforward process in practice. It usually involves some trial and error and good judgment. The good news, however, is that powerful tools and algorithms are available today.

VAR: 
$$VaR_q(X) = u + \frac{\beta}{\xi} \left( \left( \frac{n}{N_u} (1-q) \right)^{-\xi} - 1 \right)$$

$n$ : total number of observations  
 $N_u$ : number of observations exceeding the threshold  $u$ .

ES: 
$$ES_q(X) = \frac{VaR_q(X)}{1-\xi} + \frac{\beta - \xi u}{1-\xi}$$



## GPD model estimates for Tremont hedge fund indices and traditional market indices

	Excess Kurtosis	Shape parameter $\xi$	90% conf. interval for $\xi$	VaR 95% empirical	VaR 95% GPD model	VaR 99.6% GPD model
Hedge Fund Index	1.39	-0.2968	[-0.47,-0.15]	6.05%	5.88%	8.44%
Convertible Arbitrage	4.12	0.0828	[-0.17,0.35]	3.24%	2.99%	5.30%
Dedicated Short Bias	1.96	0.2814	[-0.08,0.69]	8.80%	9.37%	18.63%
Emerging Markets	3.67	0.2181	[-0.26,0.70]	9.80%	10.24%	22.14%
Equity Market Neutral	0.18	-0.2606	[-0.43,-0.07]	2.14%	2.38%	3.28%
Event Driven	21.18	0.3105	[-0.10,0.72]	3.09%	3.37%	7.15%
Fixed Income Arbitrage	13.94	0.3759	[0.06,0.69]	2.01%	2.41%	6.32%
Global Macro	1.59	0.1110	[-0.13,0.33]	9.33%	9.84%	15.89%
Long/Short Equity	2.91	0.1735	[-0.16,0.57]	7.07%	6.97%	14.90%
Tremont Managed Futures	0.84	-0.4736	[-0.88,-0.07]	7.85%	7.60%	9.97%
MSCI World Equity Index	0.35	-0.1828	[-0.36,-0.03]	8.51%	8.54%	12.54%
MSCI EU Equity Index	4.25	0.3146	[-0.07,0.70]	10.05%	10.24%	25.28%
S&P 500	0.17	0.0250	[-0.29,0.30]	8.22%	8.64%	13.51%
Lehman US Bond Index	0.20	-0.1083	[-0.37,0.16]	4.95%	4.88%	7.39%
SSB Bond Index	0.47	0.0624	[-0.39,0.40]	3.60%	3.76%	6.39%

Source: „Performance and risk measurement challenges for hedge funds: empirical considerations”, by P. Blum, M. Dacorogna, L. Jaeger , in L. Jaeger (ed.) “The New generation of risk management for hedge funds and private equity investments”, Euromoney (2003)



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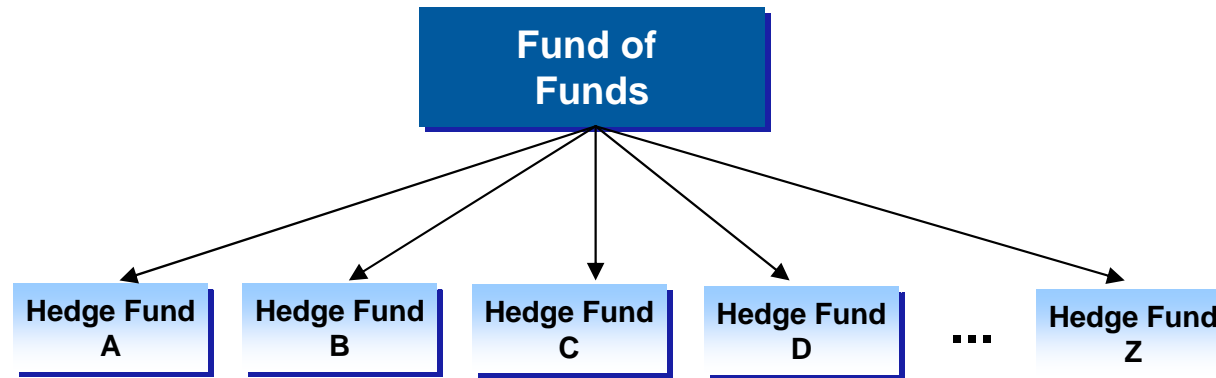
**“Passion leads to integrated investment solutions”**



## Necessity of transparency, liquidity and risk management

- The management of systematic risk needs to be distinguished from the management of manager specific risk.
- The real risk from hedge funds comes from:
  - unwanted and unknown leveraged systematic risk
  - uncontrolled manager related risk (style drifts, faulty operations, fraud, etc.)
- Exposure to systematic risk can be partially assessed without the risk manager's insights into the details of the daily portfolio through risk based factor models on the return time series of the fund.
- But only transparency and position based risk management techniques enables control of manager specific (idiosyncratic) risk.
- Hedge funds are basically the outsourced activities of proprietary trading operations at large investment banks (trading the bank's balance sheet money). Accordingly, strict independent risk management practices are in place there.
- Without Transparency no reliable risk analysis is possible, without liquidity no active risk management is possible.

# Traditional Multi Manager 'Fund of Funds' Approach



## CONSEQUENCES

### Lack of regulation

The fund of funds manager invests directly into the ("off-shore") funds of the single managers. These are mostly structured as Limited Partnership with very few regulatory restrictions only.

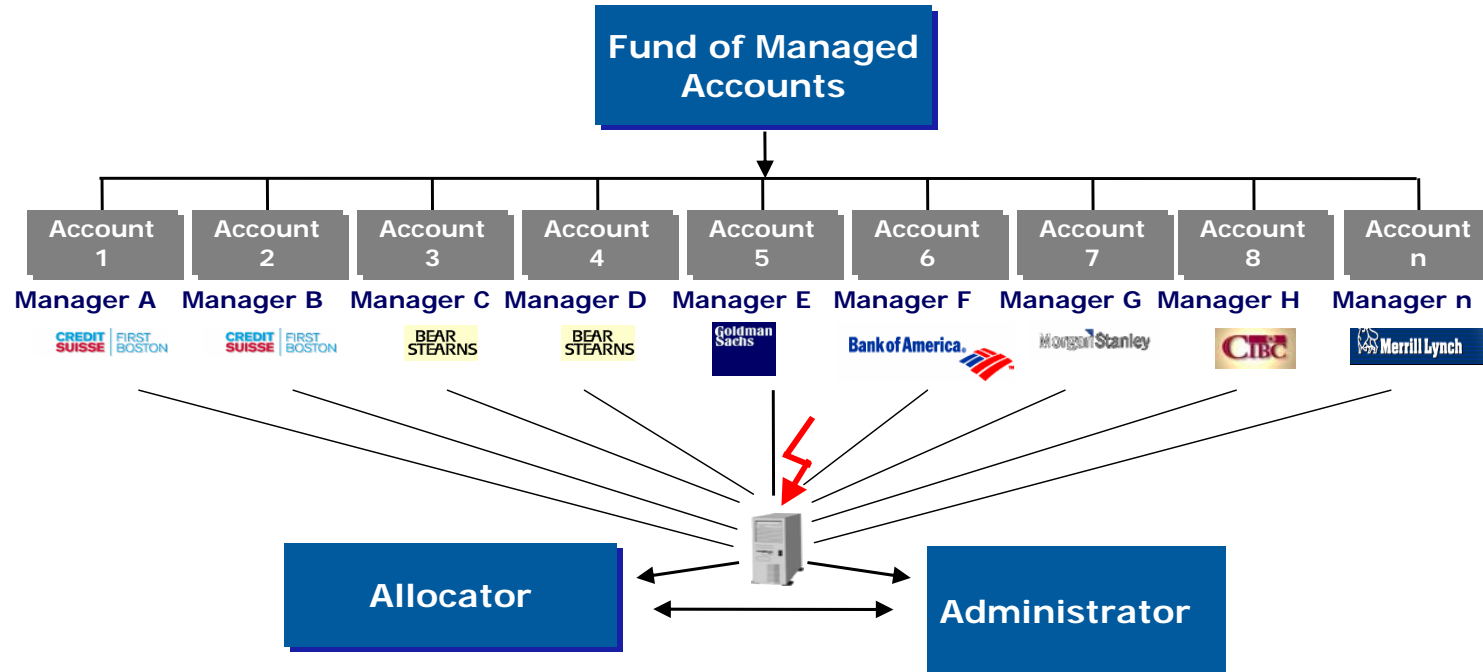
### Investors have very limited control

The investor has no direct control over the investment activities of the managers. He normally receives a monthly or quarterly summary report. His investment is subject to extended redemption periods.

→ Only very limited risk management from the fund of funds managers possible!



# Fund of Managed Account Approach

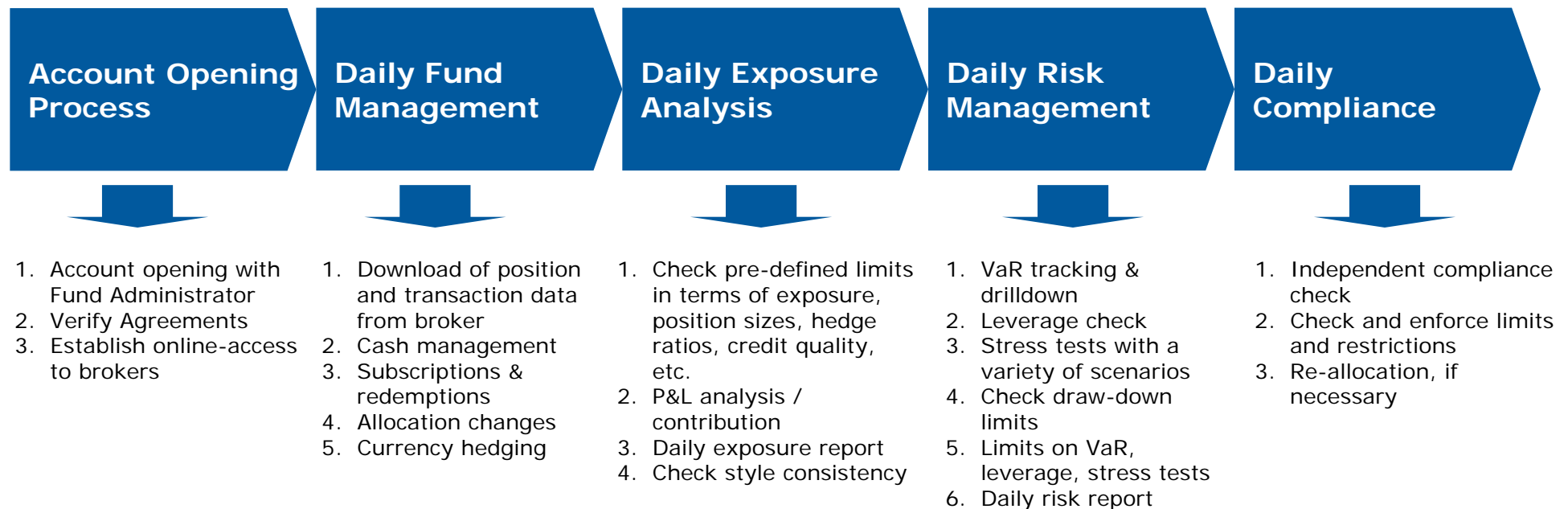


## CONSEQUENCES

- Daily Net Asset Values (NAV)
- Daily Liquidity
- Daily Transparency
- Daily Accounting
- Daily independent Risk Management

# "Risk Eye" at Partners Group

**"Risk Eye"** is a proprietary risk management process implemented at Partners Group based on **Managed Accounts approach** to **analyze, monitor** and actively **manage** the specific **risks** and **performance** in hedge fund portfolios. It downloads the relevant position and transaction data from the various prime broker and processes it into the relevant format for risk and exposure reports.

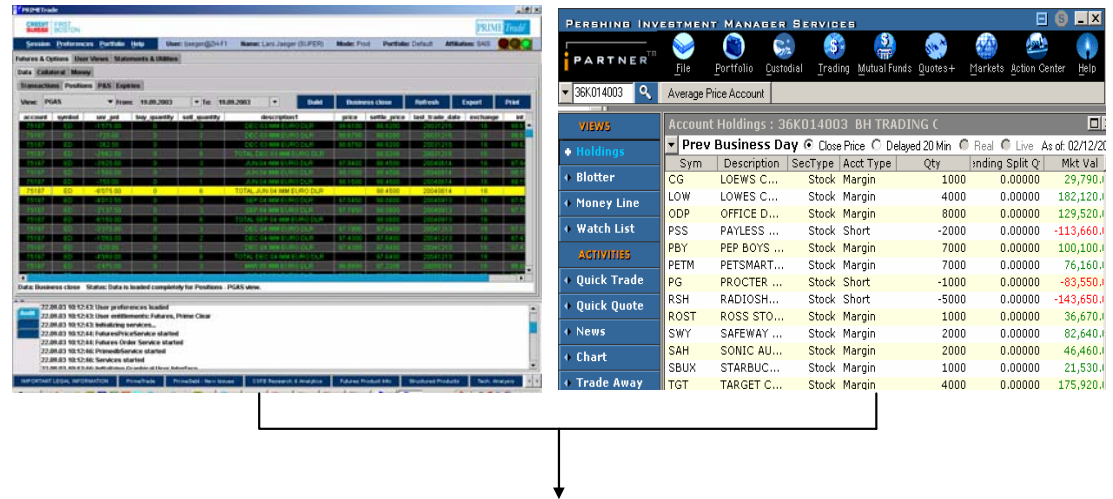




# Step 1: Data gathering / Consolidating

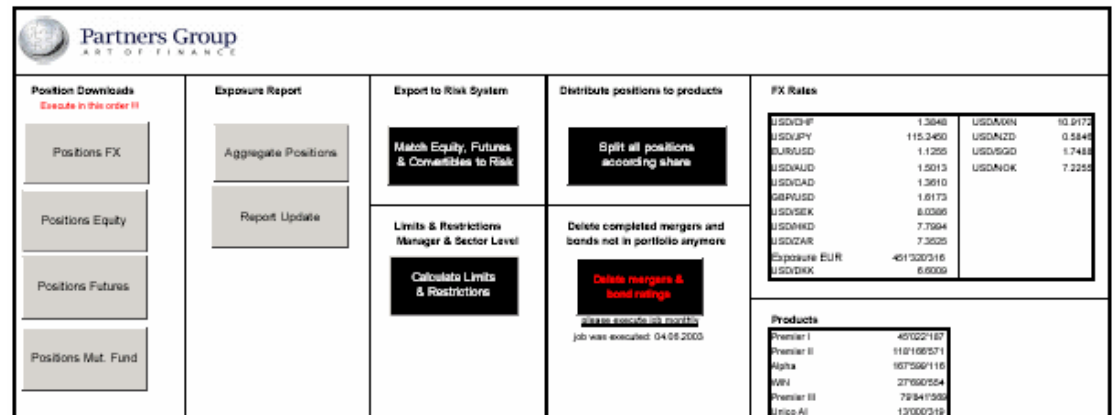
## Download position data

- Download of unconsolidated position data from approx 10 prime brokers for 20 Trading Advisors
- No standardized format available



## Consolidation of data

- Consolidating approx. 2500 position entries
- Standardized format
- Proprietary Partners Group tool based on Visual Basic, thus flexible, scalable







# Step 2: Calculation of Exposures, Leverage, MTE, position size etc.

## Calculation of risk figures

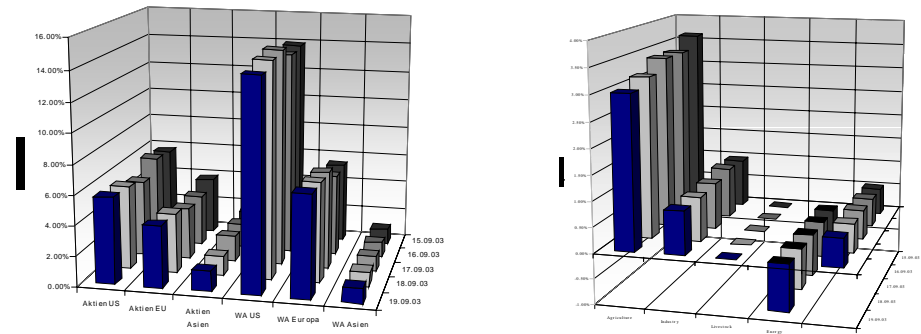
- Fully automated process to calculate
  - Exposures (Gross, Net)
  - Leverage
  - Margin to Equity (MTE)
  - Credit Exposure
  - Position sizes
- "Warn flags" in place in case of breaches

ISIN	POSITIONS	PRICE	NAME	Currency	Security Type	USD exposure	Account ID			concentration
24			<a href="#">Back to Execute</a>					long	short	>12%
020039103	-3000	47.68	ALLTEL CORP	USD	Stock	-1437040	Salutti		-1437040	ok
018804104	-3500	49	ALLIANT TECHSYSTEMS INC	USD	Stock	-171500	Salutti		-171500	ok
079860102	-2000	25.86	BELLSOUTH CORP	USD	Stock	-51720	Salutti		-51720	ok
111320107	-3000	26.85	BROADCOM CORP	USD	Stock	-80550	Salutti		-80550	ok
12709P103	-1500	62.8	CABOT MICROELECTRONICS CORP	USD	Stock	-94200	Salutti		-94200	ok
171779101	-2500	7.03	Ciena CORPORATION	USD	Stock	-17575	Salutti		-17575	ok
747906204	5000	3.46	QUANTUM CORP	USD	Stock	17300	Salutti	17300		ok
29078N107	8100	1.45	EMAGIN CORP	USD	Stock	8845	Salutti	8845		ok
339030108	8500	30.89	FLEETBOSTON FINL CORP	USD	Stock	262565	Salutti	262565		ok
M7061C100	-3000	16.29	***M-SYSTEMS /FLASH DISK	USD	Stock	-48870	Salutti		-48870	ok
31787A101	5000	2.6	FINISAR CORP	USD	Stock	13000	Salutti	13000		ok
457750107	5000	5.2	INSTINET GROUP INC	USD	Stock	26000	Salutti	26000		ok
45666Q102	3000	8.83	INFORMATICA CORPORATION	USD	Stock	26490	Salutti	26490		ok
524660107	-6500	22.8	LEGGETT & PLATT INC	USD	Stock	-148200	Salutti		-148200	ok
591002100	5500	5.25	META GROUP INC	USD	Stock	28875	Salutti	28875		ok
67066G104	-3000	20	NVIDIA CORP	USD	Stock	-60000	Salutti		-60000	ok
749941100	3000	10.28	RF MICRO DEVICES INC	USD	Stock	30840	Salutti	30840		ok
78387G103	-3000	24.04	SBC COMMUNICATIONS INC	USD	Stock	-72120	Salutti		-72120	ok
835916107	2000	8.3	SONUS NETWORKS INC	USD	Stock	16600	Salutti	16600		ok
855906103	20000	1.04	STARTECH ENVIRONMENTAL CORP	USD	Stock	20800	Salutti	20800		ok
879664100	-2000	7.43	TELLABS INC	USD	Stock	-14860	Salutti		-14860	ok
958102105	-4000	12.62	WESTERN DIGITAL CORP	USD	Stock	-50480	Salutti		-50480	ok
981402100	25000	1.65	WORKSTREAM INC	USD	Stock	41250	Salutti	41250		ok
6311003UE	3500	0.05	PUT NASDAQ 100 SHARE SEP 31.00	USD	Option	-5843	Salutti		-5843	ok
								<b>Total long</b>	<b>Total short</b>	
								492565	-968958	
								<b>Long Exp.</b>	<b>Short Exp.</b>	
								3.31%	6.45%	
								<b>Neg. Var</b>	<b>Pos. Var</b>	

max. +170% gross exposure  
min. -40% to +80% net exposure  
single position: max. 12%

## Aggregation

- Aggregation of calculated figures on Trading Advisor, Strategy and Sector Level





# Step 3: Check of limits / restrictions

## Definition of Limits / Restrictions

- Trading Advisory Agreement (TAA) detailing
  - Investment Instruments / Prohibited Instruments
  - Trading Restrictions and Limits Definitions
- Limits and Restrictions negotiated with TA and Monitoring Agents
- Limits on TA, Strategy and Sector level

### TRADING ADVISORY AGREEMENT

This Agreement herein referred to as the "Agreement" made as of the 18<sup>th</sup> of October 2002 between Partners Group Alternative Strategies PCC Limited, Guernsey (the "Company") and Partners Group (Guernsey) Limited (the "Fund Manager") and Credit Suisse Trustee Services Limited (the "Cell Trustee") and Clifton Group, Inc. (the "Trading Advisor")

WITNESSETH THAT:

WHEREAS, the Company has been incorporated as a protected cell special purpose vehicle company to offer its shareholders an opportunity to participate in a portfolio which seeks to achieve consistent capital appreciation of its assets through the trading primarily of financial instruments; and

WHEREAS, as of the date of this Agreement, the Company is offering or has sold shares, US Dollar 0.01 per value, in its segregated cell designated "Green Delta Cell", this Cell being a separate portfolio of assets and liabilities of the Company; and

WHEREAS, the Company has appointed the Fund Manager to be responsible for the general management of the Company and this Cell; and

WHEREAS, the Company has authorized the Fund Manager to allocate the Company's assets for management, which includes the allocation of assets into this specific Cell; and

WHEREAS, the Company acknowledges that the Fund Manager has delegated a number of its obligations and duties under this Agreement to the Investment Advisor in accordance with the Investment Advisory Agreement; and

WHEREAS, the Fund Manager desires to appoint the Trading Advisor to provide certain trading advisory services to, and manage certain assets of the Cell, such activities to include making investment decisions and

PGAS - Partners Group Alternative Strategies  
Limits and Restrictions

Asset Class	Relative Value	OTC / Private	Operational	Notes
Equity	100%	0%	0%	
Fixed Income	0%	0%	0%	
Commodity	0%	0%	0%	
Real Estate	0%	0%	0%	
Private Equity	0%	0%	0%	
Other	0%	0%	0%	

Primer: Produce Data Delivery  
Alpha: Produce Data Delivery

TA	Bricoleur
Strategy	LS Equity
Sector	Equity Hedged

Date	PGAS NAV	General Data					Allocation										Allocation Families	
		Gross Exp.	Net Exp.	Concetr.	Extreme ST	Extreme ST I	PGAS	Premier I	Premier II	Premier III	Alpha Inve	Alpha Inve: Ulico	W/W	Premier	Alpha			
25.06.2003	40571958	37.02%	25.87%	4.88%	-0.97%	-7.44%	8.01%	8.30%	8.53%	8.14%	7.30%	8.55%	6.53%	8.21%	8.36%	7.33%		
26.06.2003	40571938	37.05%	25.75%	4.88%	-1.00%	-7.43%	8.03%	8.34%	8.53%	8.14%	7.33%	8.55%	6.53%	8.21%	8.39%	7.36%		
27.06.2003	40487735	33.01%	23.03%	4.70%	-1.50%	-7.25%	7.93%	8.28%	8.51%	8.1%	7.29%	8.41%	6.53%	8.21%	8.34%	7.91%		
28.06.2003	40495782	100.63%	24.65%	4.70%	-1.33%	-7.50%	8.01%	5.34%	8.50%	8.14%	6.23%	8.71%	6.95%	8.22%	7.76%	8.22%		
29.06.2003	40581523	100.43%	24.55%	4.68%	-1.34%	-7.48%	7.97%	5.34%	8.50%	8.1%	6.26%	8.66%	6.96%	8.23%	7.73%	8.19%		
01.09.2003	40591712	114.16%	23.35%	11.00%	-2.71%	-8.1%	7.90%	5.3%	8.45%	8.16%	6.16%	8.00%	6.95%	8.23%	7.75%	8.05%		
02.09.2003	40592303	114.03%	24.40%	10.34%	-2.04%	-8.14%	7.94%	5.33%	8.46%	8.17%	6.19%	7.84%	7.61%	8.26%	7.78%	8.12%		
03.09.2003	40739636	116.65%	22.85%	12.60%	-2.40%	-8.12%	8.02%	5.41%	8.60%	8.18%	6.23%	7.90%	7.71%	8.24%	7.86%	8.22%		
04.09.2003	40571950	114.65%	25.03%	12.64%	-1.93%	-8.24%	8.05%	5.3%	8.5%	8.18%	6.21%	7.69%	7.66%	8.25%	7.94%	8.18%		
05.09.2003	40591741	113.00%	26.50%	12.72%	-1.62%	-8.25%	7.97%	5.3%	8.52%	8.14%	6.1%	7.51%	7.56%	8.2%	7.89%	8.06%		
08.09.2003	40778937	111.28%	31.56%	10.9%	-0.86%	-8.70%	7.83%	5.66%	8.45%	8.15%	6.06%	7.43%	7.48%	8.23%	7.86%	7.97%		
09.09.2003	40732314	105.54%	25.44%	10.18%	-1.40%	-7.86%	7.90%	5.68%	8.4%	8.13%	6.10%	7.33%	7.50%	8.22%	7.88%	8.00%		
10.09.2003	40564987	108.04%	26.85%	10.1%	-1.35%	-8.03%	7.96%	5.56%	8.3%	8.15%	7.94%	7.01%	7.25%	8.16%	7.75%	7.82%		
11.09.2003	40590519	103.05%	22.35%	10.0%	-1.70%	-7.45%	7.80%	5.54%	8.37%	8.03%	7.93%	7.00%	7.21%	8.14%	7.74%	7.91%		
12.09.2003	40531580	93.63%	25.33%	7.61%	-1.19%	-7.52%	7.73%	5.53%	8.36%	8.03%	7.92%	7.00%	7.05%	8.11%	7.76%	7.95%		
15.09.2003	40336214	103.27%	28.74%	9.31%	-1.5%	-8.34%	7.74%	5.48%	8.28%	8.07%	7.86%	6.32%	7.05%	8.11%	7.70%	7.73%		
16.09.2003	40524317	108.39%	23.29%	9.32%	-1.06%	-8.38%	7.73%	5.48%	8.29%	8.06%	7.85%	6.30%	7.00%	8.10%	7.70%	7.71%		
17.09.2003	40375900	103.16%	19.95%	10.01%	-2.44%	-7.44%	7.84%	5.95%	8.3%	8.08%	7.93%	6.36%	7.01%	8.1%	7.84%	7.95%		
18.09.2003	40594255	119.05%	26.71%	9.33%	-1.95%	-8.62%	7.73%	5.19%	8.28%	8.10%	7.88%	6.31%	8.05%	8.17%	7.73%	7.74%		
19.09.2003	40516180	125.45%	28.10%	10.07%	-2.06%	-8.08%	7.88%	5.17%	8.05%	8.14%	7.87%	6.31%	6.94%	8.15%	8.14%	7.73%		

## Daily check

- Fully automated process
- "Warn flags"
- 4 eye principal



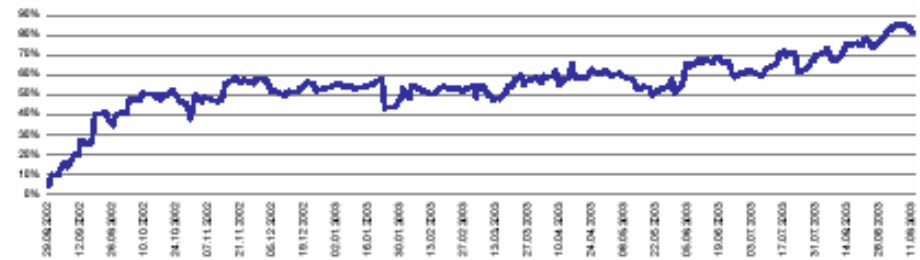
# Limits / Restrictions Example: Long Short Equity / Equity Market Neutral

Long / Short Equity

Net Exposure



Gross Exposure



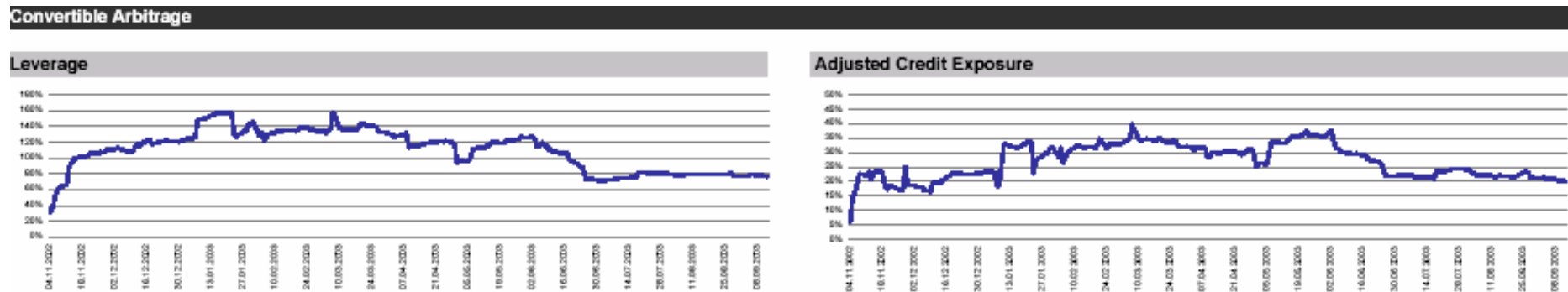
## Limits / Restrictions (Manager / Aggregated strategy level)

- Fully automated process
- Gross Exposure
- Net Exposure
- Concentration
- Liquidity constraints
- Stress Tests based on Exposure



# Limits / Restrictions Example: Relative Value - Convertible Arbitrage

36



## Limits / Restrictions (Manager / Aggregated strategy level)

- Leverage
- (Adjusted) Credit Exposure
- Hedge Ratio
- Concentration
- Liquidity constraints
- Issue Size
- Stress Tests on IR Shifts, Equity shifts, Volatility shifts

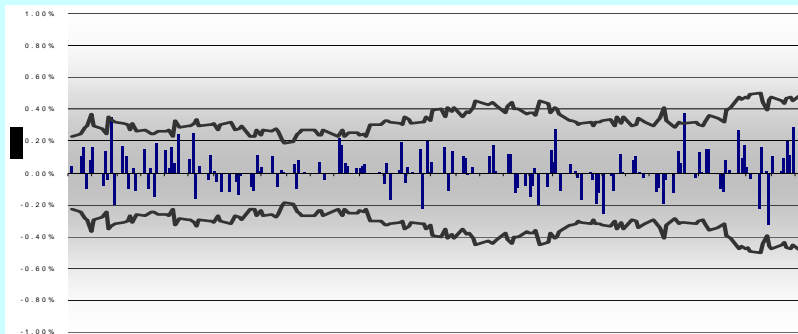


## Step 4: Comprehensive Risk Measurement and Analysis

37

### Value at Risk (VaR) Approach

- “Normal” market environment
- Max. portfolio loss within a certain confidence level over a specified trading horizon (PG: 99% / 1 day / Monte Carlo simulation)



### Stress Test / Scenario Analysis

- “Extreme” market environment
- Behavior of the portfolio under extreme market scenarios

Stress Tests (P&L) analysis on manager portfolio\*

Equity / Currency / Commodity	-10%	-5%	+5%	+10%
Equity Shift (S&P 500)	-1.31%	-0.74%	0.89%	1.97%
USD shift against FX basket	0.69%	0.32%	-0.27%	-0.48%
Commodity basket shift	-0.50%	-0.31%	0.43%	0.96%
Interest Rates	-50bp	-25bp	+25bp	+50bp
Parallel shift of US Gov't curve	-0.04%	-0.02%	0.02%	0.05%
Credit spreads	0.12%	0.06%	-0.15%	-0.12%
Scenarios				
September 11, 2001	-1.54%			
Russian Devaluation (Aug 98, 5 days)	-0.65%			

Where **VaR** attempts to measure the risk of low probability events in normal markets, **stress testing** looks at the risk of plausible events in abnormal markets.

# Step 5: Daily risk reporting to Investors

## Risk report to investors

- Detailed analysis on
  - VaR / Backtesting
  - VaR Drilldown to Asset Classes / Managers
  - Stress Testing
  - Current portfolio allocation to sectors
  - Allocation characteristics by strategy sector
  - Bond / Convertible Bond Exposure
  - Currency Exposure
  - Commodity Exposure
- Daily updated
- Made available to investors through Internet / eMail
- Recognize major changes over the last days
- Daily analysis by 5 risk professionals

Täglicher Risikobericht  
per 25.09.2003 (basierend auf Daten vom 24.09.2003)

### Alpha-Invest I

NAV Information		Value at Risk (VaR) / Täglicher Gewinn/Verlust											
DZ-Info-NET	Eigenescht.-Angebot:Prod.-Eigenanlagens-fonds-Info												
Kaufersseite	UCDO1												
Börsengang	ALNVLK- <i>(Equity)</i> -KDD												
Union-Online	Fonds												
<b>Risikokennzahlen per 29.08.2003*</b>													
Annualisierte Rendite	4,21%												
Annäherungs-Standardabweichung	1,62%												
Sharpe Ratio (r: 3,050)	0,75												
Korrelation zum S&P 500 Index	0,04												
Korrelation zum MSCI World Index	0,1												
Korrelation zum Citigroup World Government Bond Index	0,46												
<b>Allokationsübersicht / Allokationscharakteristika</b>													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Sektorallokation</th> <th>Relative Value</th> </tr> </thead> <tbody> <tr><td>Equity Hedge</td><td>35,25%</td></tr> <tr><td>Future Strategies</td><td>13,22%</td></tr> <tr><td>Opportunistisch</td><td>15,29%</td></tr> <tr><td>Cash / Money Market</td><td>11,74%</td></tr> </tbody> </table>				Sektorallokation	Relative Value	Equity Hedge	35,25%	Future Strategies	13,22%	Opportunistisch	15,29%	Cash / Money Market	11,74%
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<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Merger-Arbitrage</th> <th>Long Exposure</th> <th>Netto Exposure</th> <th>Große Einzelposition</th> </tr> </thead> <tbody> <tr><td></td><td>77,36%</td><td>48,33%</td><td>3,17%</td></tr> </tbody> </table>		Merger-Arbitrage	Long Exposure	Netto Exposure	Große Einzelposition		77,36%	48,33%	3,17%				
Merger-Arbitrage	Long Exposure	Netto Exposure	Große Einzelposition										
	77,36%	48,33%	3,17%										
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Convertible Arbitrage</th> <th>Adjusted Credit Exposure</th> <th>Hedged Ratio</th> <th>Große Einzelposition</th> </tr> </thead> <tbody> <tr><td></td><td>26,90%</td><td>50,69%</td><td>4,60%</td></tr> </tbody> </table>		Convertible Arbitrage	Adjusted Credit Exposure	Hedged Ratio	Große Einzelposition		26,90%	50,69%	4,60%				
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	#VALUE!	#VALUE!	#VALUE!										
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Equity Market Neutral</th> <th>Breite Exposure</th> <th>Netto Exposure</th> <th>Große Einzelposition</th> </tr> </thead> <tbody> <tr><td></td><td>#VALUE!</td><td>#VALUE!</td><td>#VALUE!</td></tr> </tbody> </table>		Equity Market Neutral	Breite Exposure	Netto Exposure	Große Einzelposition		#VALUE!	#VALUE!	#VALUE!				
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	#VALUE!	#VALUE!	#VALUE!										
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Futures</th> <th>Margen To Equity (MTE) Total</th> <th>Actual MTE</th> <th>Actual MTE - Aktien</th> <th>Actual MTE - Wertpapiere</th> <th>Actual MTE - Renten</th> </tr> </thead> <tbody> <tr><td></td><td>7,54%</td><td>44,43%</td><td>40,77%</td><td>2,78%</td><td>12,62%</td></tr> </tbody> </table>		Futures	Margen To Equity (MTE) Total	Actual MTE	Actual MTE - Aktien	Actual MTE - Wertpapiere	Actual MTE - Renten		7,54%	44,43%	40,77%	2,78%	12,62%
Futures	Margen To Equity (MTE) Total	Actual MTE	Actual MTE - Aktien	Actual MTE - Wertpapiere	Actual MTE - Renten								
	7,54%	44,43%	40,77%	2,78%	12,62%								

**VaR Analyse: Aufteilung nach Anlagekategorien**

**VaR Analyse: Aufteilung nach Manager**

**Klassifizierung:** Risikoberechnung ist ein Markt-bezogenes Verfahren. Die Variablen sind nicht absolut, sondern relativ zu den Basiswerten. Die Berechnung ist ein Prozess, der sich über die Zeit ändert und von den Marktbedingungen abhängt.

**Ergebnisse:** Die Ergebnisse sind nur für den Zeitraum der Berechnung gültig. Die Ergebnisse sind nicht als Empfehlung für den Handel zu verstehen.

**Stress Test:** Die Stress Test Ergebnisse sind nur für den Zeitraum der Berechnung gültig. Die Ergebnisse sind nicht als Empfehlung für den Handel zu verstehen.

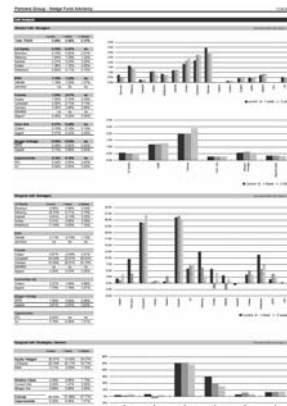
**VaR zu Risk (VaR):** Der VaR ist die maximale Verluste, die über einen bestimmten Zeitraum mit einer bestimmten Wahrscheinlichkeit zu erwarten sind.

# Internal Risk Analysis



## Weekly Risk Report to the Investment Committee

- Approx 20 pages
- Headlines / Major Developments
- Comprehensive Analysis of Exposures, Leverage, VaR, Marginal VaR
- Stress Testing Analysis
- Comprehensive Analysis on Manager level



Partners Group - Hedge Fund Advisory 13.09.2003

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**Manager Information**

Manager	Solar Capital Inc	Cell AUM (current)	USD	20,341,450
Program	SCI European	Allocation in % Total AUM		3.93%
PICIS Cell Name	Blue Side	VaR (with respect to allocated assets)	USD	1.07%

---

**Statistical Analysis / MTE Analysis**

Risk		
Return $\mu$	-5.57%	
Standard Deviation $\sigma$	7.79%	
Skurge Ratio (w/ 1%)	-0.90	
Sortino Ratio (10%)	n.a.	
Max. Drawdown (date)	1.32%	
Max. Drawdown (Peak to Trough)	-2.12%	
Recovery Period (Months)	n.a.	
Drawdown Status	n.a.	
Drawdown Concern Limit	-0.00%	

---

**Exposure Analysis**

Gross Exposure	max: +1.70%	66.15%
Net Exposure	min: -0.5% / max: +8.0%	41.20%
Concentration	max: 12%	3.54%

---

**Exposure Development**

---

**Drawdown Analysis**

---

**Distribution of Returns**

---

**VaR Analysis**

Development of VaR / PML (VaR backtesting)

Marginal VaR: Drawdown to Risk Types

---

**Stress Test Analysis**

Equity / Currency / Commodity	Predictive	+15%	+10%	+5%	-5%	-10%	-15%
Global Equity Shift (World Index)	Simple	0.00%	2.00%	1.71%	-1.88%	-3.53%	-4.92%
Global Equity Shift (World Index)	Simple	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
USD shift against FX basket	Predictive	-2.89%	-2.01%	-1.04%	1.10%	2.25%	3.44%
USD shift against FX basket	Simple						
Commodity basket shift	Predictive	0.60%	0.93%	2.89%	-2.84%	-0.62%	-3.34%
Commodity basket shift	Simple						

---

**Interest Rates**

Interest Rates	+100bp	+50bp	+25bp	-25bp	-50bp	-100bp
Parallel shift of US Government curve	Simple	-0.01%	0.00%	0.00%	0.00%	0.01%
Credit Spreads	Simple	0.00%	0.00%	0.00%	0.00%	0.00%

---

**Combined Stress Tests**

Equity Indexes -4% / Interest Rates +25bp / Credit Spreads +10% / Commodity (USD) -4% / Commodity (EUR) +1%	Simple	-2.21%
Equity Indexes -15% / Interest Rates +50bp / Credit Spreads +10% / Commodity (USD) -10% / Commodity (EUR) +1%	Simple	-4.41%

---

**Scenarios**

September 11, 2001	Predictive	-4.47%
Russian Devaluation (Aug 99, 5 days)	Predictive	-2.08%

---

**Global Equity Shift (Indices) -5% / +5%**

**FX Shift (USD ag. Basket) -5% / +5%**

**IR Shift (US and EUR gov. curve) -2% / +2%**

---

**Allocations in Products**

For definitions and application turn to last page



## Active Risk Management

- Limiting exposure to particular sectors and “risk budgets” (maximally allowed VaR for different risk factors, e.g. specific currencies, equity markets, commodity market sectors, or geographical regions); maximal risk limit (VaR) for global portfolio according to investor’s profile
- Tactical allocation shifts based on risk management
- Reallocation in case VaR limit for particular risk factor or the entire portfolio is permanently exceeded
- De-allocation in case style changes or undesired major “bets” of a manager is recognized
- Different specific stress test limits depending on current market environment and investor’s profile
- Monitoring and limiting exposure by limiting leverage factor (margin requirements) for each individual manager



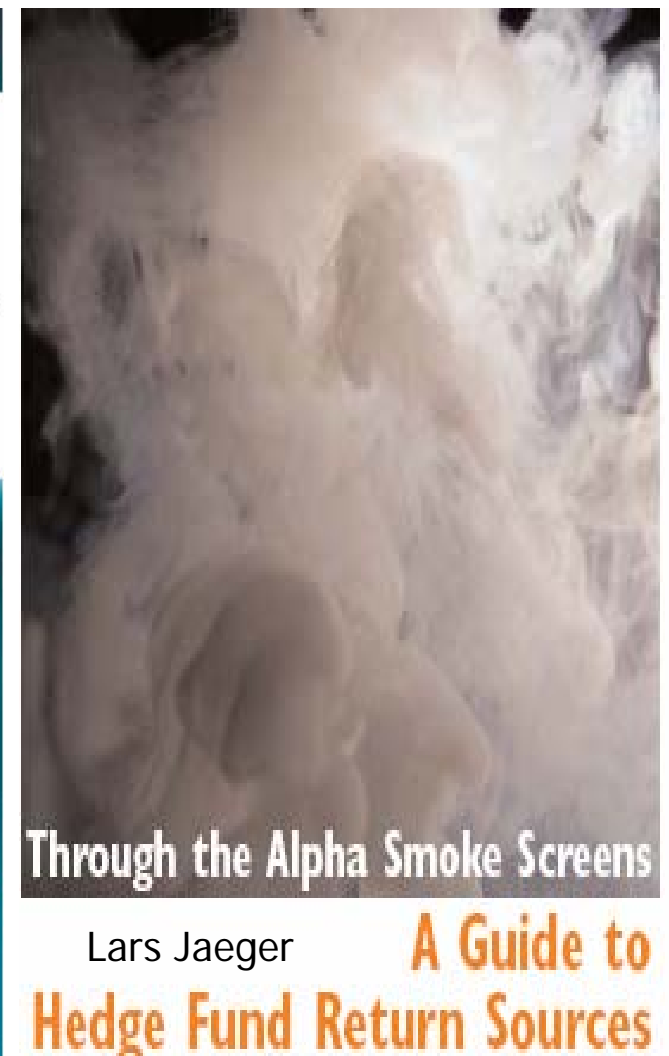
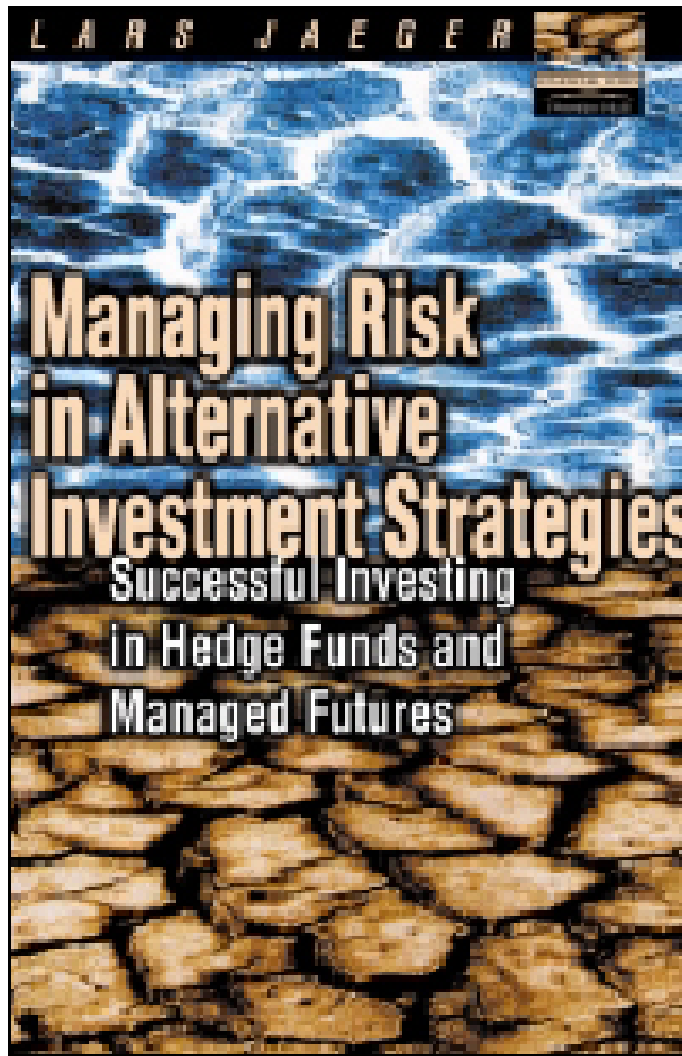


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- Schneeweis, T., Kazemi, H., Martin, G., "Understanding Hedge Fund Performance", Lehman Brothers Publications (November 2001)



# Literature





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Passion for Alternative Investments

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