BENEFITS OF ALLOCATION OF TRADITIONAL PORTFOLIOS TO HEDGE FUNDS

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ABSTRACT

In this paper we show that **allocation of traditional portfolios to hedge funds is beneficial in terms of risk–return trade-off both in periods of bull markets and in periods of bear or sideways markets.**
The optimal allocation to hedge funds varies over time and as a consequence our approach is the application of active investment management, modifying weights among traditional asset classes and hedge fund strategies according to the forecasted expected returns.
To make hedge fund risk-return profiles comparable with traditional asset classes **we have adjusted hedge fund returns to consider most of the acknowledged biases**, and more importantly we have built a model that **accounts for the significant non-normality of the distribution** of hedge fund returns in the optimization process.

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DATA

As a source of data for hedge funds we used the Tremont database with monthly returns from January 1994 through January 2004 for each of the most important and commonly recognized strategies:

Convertible Arbitrage
Dedicated Short
Emerging Markets
Equity Market Neutral
Event Driven
Distressed
E.D. Multi Strategy
Risk Arbitrage
Fixed Income Arbitrage
Global Macro
Long/Short Equity
Managed Futures
Multi Strategy

As a proxy for equities in the bull market period we used S&P500 monthly returns from January 1994 through December 2000.

For current traditional portfolio allocation to hedge funds we use monthly returns of the following indices:

DJ EURO STOXX 50 (Europe ex UK)
S&P500 (USA)
NIKKEI 225 (Japan)
FTSE-100 (UK)
FTSE AW TR All Emerging
Merrill Lynch US CORPORATES A-AAA
Merrill Lynch US CORPORATES BBB RATED
Merrill Lynch EMU ALL NON-SOVEREIGNS AAA RATED
Merrill Lynch EMU ALL NON-SOVEREIGNS BBB RATED
Merrill Lynch USD BBB-B EMG MKTS SOVEREIGNS
Merrill Lynch EUR BBB-B SOVEREIGNS
Merrill Lynch AAA US TREASURIES/AGCY 7-10YR
Merrill Lynch PAN-EUROPE GOVTS 7-10YR
Merrill Lynch JAPANESE GOVTS 7-10YR
Merrill Lynch SWISS GOVTS 7-10YR
Merrill Lynch USD LIBOR 1-MO CONST MAT
Merrill Lynch EURO CURRENCY LIBOR 1-MO CONST MAT

for the period from January 2000 through January 2004.

OUR MODEL

The model we have used is an application of the PMPT (post modern portfolio theory) that considers in addition to the two commonly used moments of the distribution of returns (mean and variance) also the third (skewness) and fourth (excess kurtosis) moment.
The extension to the latter two elements of the distribution is particularly important when hedge funds are included in the optimization process because of their significant asymmetry of returns mainly due to their use of non-linear financial instruments (i.e. options).
Assuming that the only risk that really concerns investors is the downside one, we built our model on the Modified-Value-at-Risk (MVaR) measure, with an increase of VaR probability to 99% to strengthen the effects of skewness and kurtosis in the optimal portfolio weights in order to control the extreme tail risks. To include third and fourth moments in the computation of risk we applied the Cornish-Fisher expansion.
After having defined the expected returns for every asset class, the optimization process finds the portfolio with the minimum MVaR, subject to a minimum level of return; furthermore every asset class weight could be forced to range between an upper and a lower constraint.
The model has been run for a range of returns / MVaR thus allowing us to identify all the efficient portfolios and the corresponding efficient frontier: the Optimal Portfolio is the one on the frontier that is furthest to the left with no cash among its component asset classes. In other word the Optimal Portfolio is represented by the tangency point between the efficient frontier and the straight line with intercept on the Y axis (returns) at the Risk Free Rate level. To tailor (increase or reduce) the portfolio risk to the Investor's required level, money has to be borrowed or lent at the Risk Free Rate while maintaining constant the Optimal Portfolio's asset mix.
The problem of building an Optimal Portfolio is separated into somehow finding the optimal mix and then combining it with cash to give the investor the desired risk tolerance (see explanatory graph in Appendix A).

In Appendix B we have made a comparison of the results obtained by applying the MVaR model and the classic Mean-Variance model.

BIAS

A large amount of literature has been published on the estimates of various biases in the hedge fund industry.
Some bias cannot be measured (e.g. self reporting bias) while others are dependent on the database construction criteria.
In this document we have considered the bias impact in the following terms:

Survivorship, selection and instant history bias: 2 % / year

Liquidity bias: 2,76 % / year

The return of each hedge fund strategy has been reduced accordingly for the estimate of the expected returns but not for the analysis of historical return patterns (distribution moments and covariance matrix) for which the reported returns have been used.
The introduction of biases makes hedge fund returns comparable with traditional asset classes allowing the model to identify an optimal allocation of traditional portfolios to hedge funds.
The bias impact has been considered the same for each hedge fund strategy and this naïve assumption has still to be validated.

FINDINGS

We have applied the model to two subsequent time periods characterized by extremely different market conditions. The first period saw a strong bull market with S&P500 performance exceeding 16% annually. The common sentiment is that the best asset allocation would have been heavily weighed towards equities while hedge funds would not have been very beneficial to a portfolio's overall performance. The second period that was examined is the end of the bubble, the bear market and the current environment characterized by fluctuations in both directions.

Period from January 1994 through December 2000

We have applied the model to monthly returns of hedge fund strategies, the S&P500 and cash.
Expected returns for each hedge fund strategy have been defined as the average of the class over the whole period less the bias adjustment factor.
Expected returns for the S&P500 and cash are the annualized compounded returns of the indices (see TABLE 1).

A summary of each asset class's historical data is reported in TABLE 2.

We have computed the optimal portfolio weights and the corresponding MVaR for a range of minimum portfolio returns:

PORTFOLIO DATA SUMMARY 94 - 00

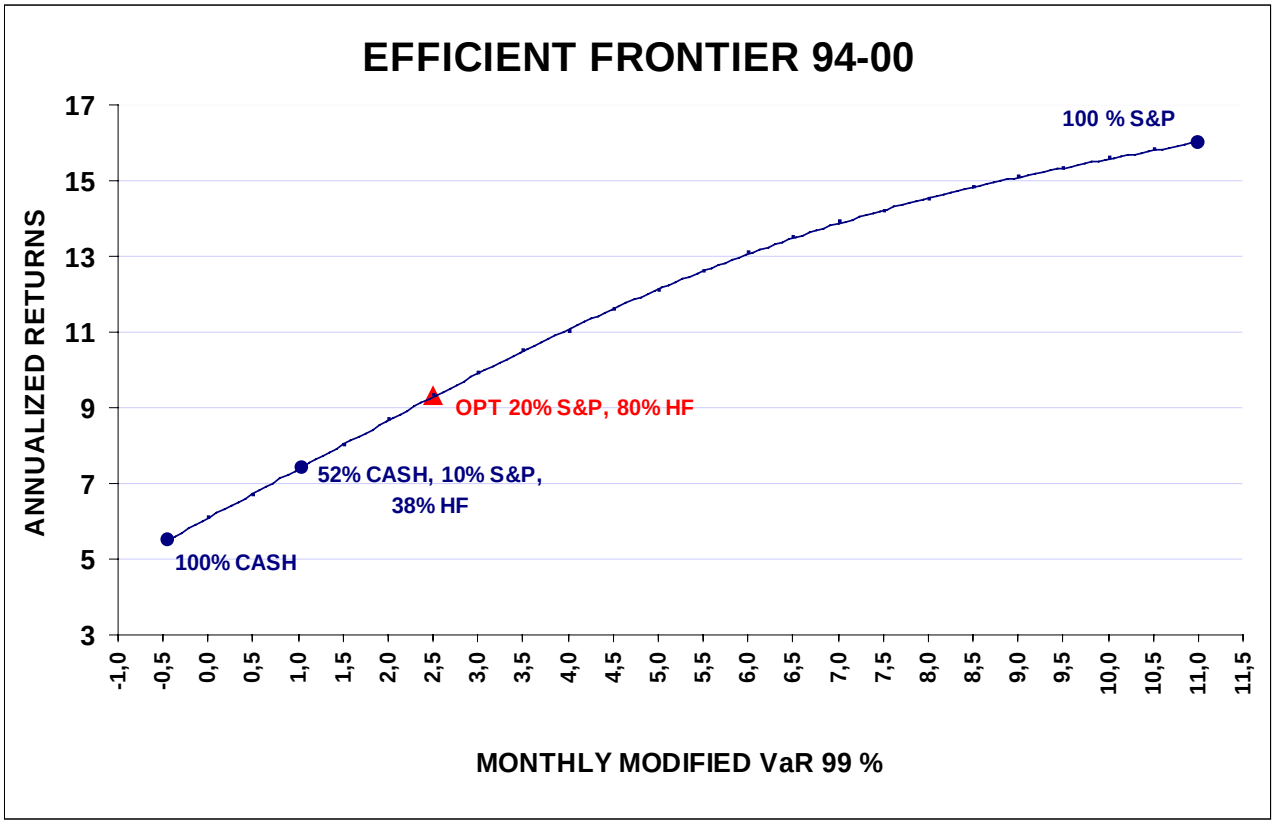
ANNUALIZED RETURNS	MVaR	CASH %	S&P500 %	HF %	MONTHLY DEVIATION	SKEWNESS	EXCESS KURTOSIS
5,5	-0,46	100	0	0	n.a.	n.a.	n.a.
6,0	-0,07	87	3	10	0,20	-0,18	-0,25
7,0	0,71	62	8	30	0,50	-0,18	-0,25
8,0	1,48	36	13	51	0,90	-0,18	-0,25
9,0	2,26	10	18	72	1,30	-0,18	-0,25
9,4	2,57	0	20	80	1,40	-0,18	-0,25
10,0	3,07	0	24	76	1,60	-0,55	1,10
11,0	3,98	0	32	68	1,90	-0,55	1,10
12,0	4,93	0	39	61	2,20	-0,54	1,19
13,0	5,93	0	47	53	2,50	-0,52	1,31
14,0	7,14	0	59	41	2,90	-0,48	1,67
15,0	8,89	0	79	21	3,30	-0,64	1,62
16,0	10,89	0	99	1	4,10	-0,77	1,35

All the portfolios above are "efficient portfolios" i.e. they belong to the efficient frontier and the optimal portfolio is the highlighted one.

The 80% allocation to hedge funds is split among individual strategies as follows:

- Equity Market Neutral 52 %
- Long / Short Equity 14 %
- Global Macro 14 %

It is interesting to notice that even in one of the best periods for equities in the last decades a significant allocation to hedge funds is recommended by the model.


EFFICIENT FRONTIER 94-00
ANNUALIZED RETURNS
17
15
13
11
9
7
5
3
100 % S&P
OPT 20% S&P, 80% HF
52% CASH, 10% S&P,
38% HF
100% CASH
-1,0
-0,5
0,0
0,5
1,0
1,5
2,0
2,5
3,0
3,5
4,0
4,5
5,0
5,5
6,0
6,5
7,0
7,5
8,0
8,5
9,0
9,5
10,0
10,5
11,0
11,5
MONTHLY MODIFIED VaR 99 %

Period from January 2000 through January 2004

We have applied the model to generate the optimal current (January 2004) asset allocation based on monthly returns of hedge fund strategies and of traditional asset classes (listed above) with the addition of forecasted expected returns.
Our time horizon for active investment management is six months, and the forecast of the expected returns entered into the model is consistent with this choice.
The historical data have been used to derive, within the model, the distribution moments and the covariance matrix which are assumed to be constant through time.

Expected returns have been estimated using the following methodology:

- the average return over the most recent 12 months, net of bias, for hedge fund strategies

- our strategist's six months forecast for traditional asset classes

The six months forecast period is consistent with active investment management approach which allows for investment / disinvestment in the majority of hedge funds.

A summary of the expected returns is reported in TABLE 3 and each asset class's historical data is reported in TABLE 4.

The model identifies the optimal portfolio in terms of minimum Modified-Value-at-Risk subject to a minimum portfolio rate of return.

PORTFOLIO DATA SUMMARY 00 – 04

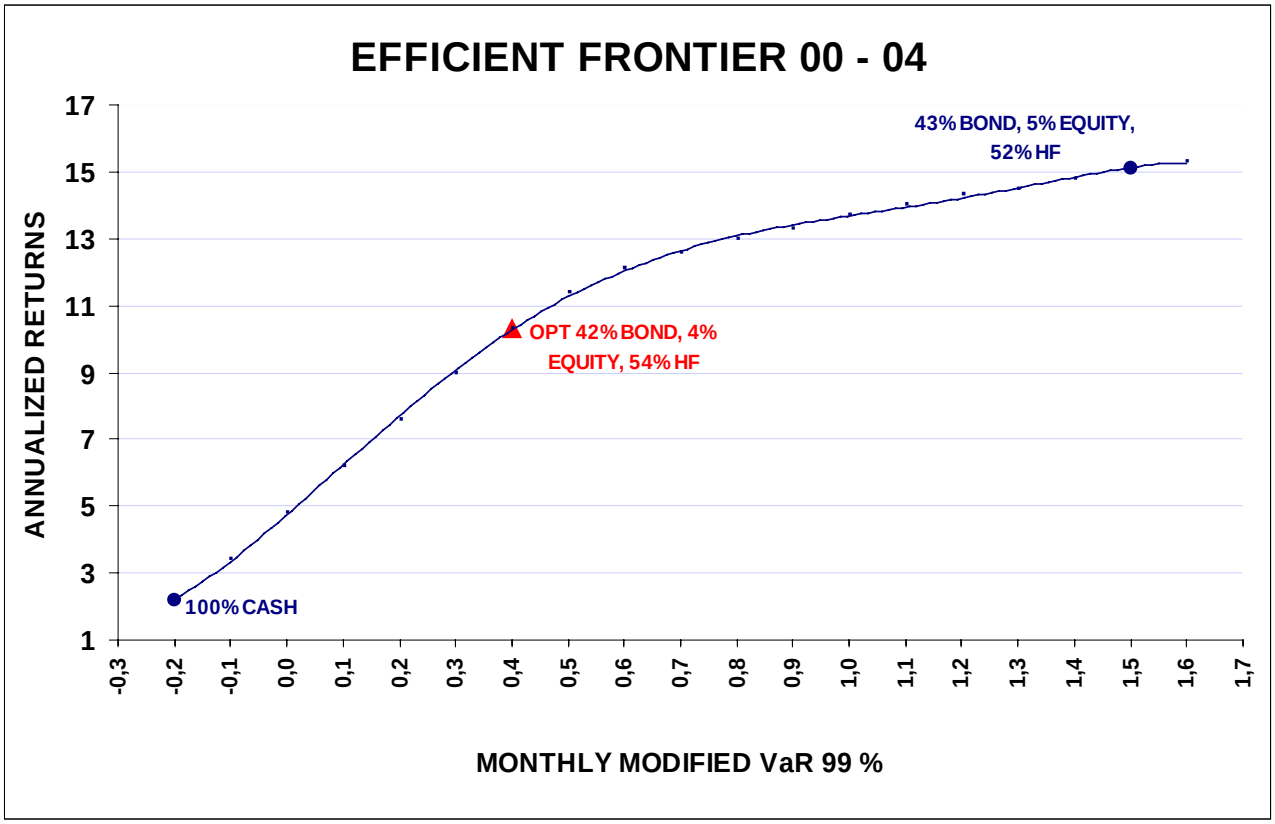
ANNUALIZED RETURNS	MVaR	CASH %	GOV'T BONDS %	EQUITY JAPAN %	HF %	MONTHLY DEVIATION	SKEWNESS	EXCESS KURTOSIS
2,2	-0,18	100	0	0	0	n.a.	n.a.	n.a.
3,0	-0,13	90	5	0	5	0,08	0,70	-0,17
4,0	-0,06	76	10	1	13	0,17	0,70	-0,17
5,0	0,01	63	15	1	21	0,27	0,70	-0,17
6,0	0,09	50	21	2	27	0,37	0,70	-0,17
7,0	0,16	37	27	2	34	0,47	0,70	-0,17
8,0	0,23	23	32	3	42	0,56	0,70	-0,17
9,0	0,30	10	38	3	49	0,66	0,70	-0,17
9,8	0,36	0	42	4	54	0,74	0,70	-0,18
10,0	0,37	0	43	4	53	0,76	0,70	-0,20
11,0	0,46	0	43	4	53	0,85	0,64	-0,32
12,0	0,59	0	43	0	57	0,81	0,24	-0,72
13,0	0,80	0	46	2	52	0,90	0,12	-0,56
14,0	1,11	0	49	3	48	1,00	-0,03	-0,33
15,0	1,48	0	43	5	52	1,11	-0,22	-0,08
16,0	1,88	0	37	7	56	1,25	-0,37	0,04

All portfolios are “efficient portfolios” i.e. they belong to the efficient frontier and the optimal portfolio is the highlighted one.

The 54% allocation to hedge funds is split among individual strategies as follows:

- Convertible Arbitrage 18 %
- Multi Strategy 14 %
- Emerging Markets 10 %
- Equity Market Neutral 9%
- Distressed 3 %

It is interesting to notice that moving to the right of the optimal portfolio, along the line of the efficient frontier, the total allocation to hedge funds does not change very much, ranging in the 48% - 57% interval. The significant change of the portfolio composition is in the allocation to the individual strategies, emphasizing again the role played by the specific hedge fund strategies in the investment decisions.


EFFICIENT FRONTIER 00 - 04
ANNUALIZED RETURNS
17
15
13
11
9
7
5
3
1
43% BOND, 5% EQUITY, 52% HF
OPT 42% BOND, 4% EQUITY, 54% HF
100% CASH
-0,3
-0,2
-0,1
0,0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1,0
1,1
1,2
1,3
1,4
1,5
1,6
1,7
MONTHLY MODIFIED VaR 99 %

CONCLUSIONS

The risk-return profiles of **hedge funds are extremely beneficial to actively managed portfolios both in terms of return enhancement and risk diversification**. The overall portfolio volatility is heavily reduced and the trade-off return-risk is improved.
The introduction of hedge fund bias in a very significant way should avoid widespread criticism against these investment instruments and make their abnormal performances comparable with those of traditional asset classes.
The diversification to hedge funds is recommended both in periods of bear and bull markets with different weights consistent with prevailing market conditions.
However, it is evident that hedge funds are not one single asset class: emphasis then must be put on individual hedge fund strategies as each of these should be considered a unique asset class with its own risk-reward features.
Consequently, in the optimal asset allocation process, the selection of the appropriate hedge fund strategies according to the market outlook is fundamental and, in order to maximize results, emphasis must be put on the estimation of individual strategies expected returns.
In the ten-year period that we have analyzed, the optimal allocation to hedge funds has ranged from a minimum of 54% up to 80% of the entire portfolio. It must be said that no upper limit to any asset class has been implemented, and therefore the model has been allowed to select the best portfolio regardless of potential constraints that otherwise could be imposed from a qualitative point of view.
According to this study it appears that it is extremely rationale to consider hedge funds as viable financial instruments and to include them in a portfolio allocation process not only as they can provide a significant portion of superior returns but also because they can help in controlling tail risks: the risk control is also a result of a fundamental job of manager selection, due diligence and ongoing monitoring.
It also appears that there is a need for active investment management as the maximization of the trade-off risk-return stems from dynamic strategy allocation.

TABLE 1

EXPECTED RETURNS

	Jan 94 - Dec 00 ANNUAL AVERAGE RETURN	BIAS	YEARLY NET EXPECTED RETURN
Convertible Arbitrage	10,18	4,76	5,42
Dedicated Short	0,92	4,76	-3,84
Emerging Markets	6,49	4,76	1,73
Equity Mkt Neutral	11,30	4,76	6,54
Event Driven	11,51	4,76	6,75
Distressed	12,59	4,76	7,83
E.D. Multi Strategy	11,21	4,76	6,45
Risk Arbitrage	10,18	4,76	5,42
Fixed Income Arbitrage	6,52	4,76	1,76
Global Macro	13,68	4,76	8,92
Long/Short Equity	15,75	4,76	10,99
Managed Futures	5,86	4,76	1,10
Multi Strategy	9,48	4,76	4,72
S&P500	16,06		16,06
Cash (1 month eurodollar)	5,45		5,45

TABLE 2

SUMMARY OF JAN 94 – DEC 00 DATA

	SHARPE RATIO rfr 5.5 %	MEAN MONTHLY RETURN	MONTHLY STANDARD DEVIATION	SKEWNESS	EXCESS KURTOSIS	MONTHLY MODIFIED VaR 99%
Convertible Arbitrage	1,02	0,85	1,45	-1,65	4,17	4,64
Dedicated Short	-0,24	0,08	5,48	1,00	2,38	10,05
Emerging Markets	0,06	0,54	5,88	-0,46	2,40	18,42
Equity Market Neutral	1,86	0,94	0,99	-0,03	-0,17	1,74
Event Driven	1,00	0,96	1,90	-3,63	23,06	9,77
Distressed	1,05	1,05	2,14	-2,95	17,50	10,76
Risk Arbitrage	1,13	0,85	1,31	-1,65	8,54	5,50
Fixed Income Arbitrage	0,27	0,54	1,25	-3,29	15,75	5,31
Global Macro	0,63	1,14	4,11	0,00	0,67	9,47
Long/Short Equity	0,91	1,31	3,63	-0,01	2,18	9,43
Managed Futures	0,04	0,49	3,29	0,21	1,31	8,04
Multi Strategy	0,85	0,79	1,47	-1,31	2,58	4,41
S&P500	0,74	1,25	4,13	-0,77	1,35	11,03
Euro Dollar 1 months	n.a.	0,45	n.a.	n.a	n.a.	n.a.

TABLE 3

EXPECTED RETURNS

		Feb 03 - Jan 04 SEMI ANNUAL RETURN	6 MONTHS BIAS	6 MONTHS EXPECTED RETURN
Convertible Arbitrage		5,33	2,38	2,95
Dedicated Short		-18,70	2,38	-21,08
Emerging Markets		14,32	2,38	11,94
Equity Mkt Neutral		3,68	2,38	1,30
Event Driven		9,15	2,38	6,77
Distressed		10,98	2,38	8,60
E.D. Multi Strategy		8,01	2,38	5,63
Risk Arbitrage		4,95	2,38	2,57
Fixed Income Arbitrage		3,84	2,38	1,46
Global Macro		8,07	2,38	5,69
Long/Short Equity		9,11	2,38	6,73
Managed Futures		4,60	2,38	2,22
Multi Strategy		7,12	2,38	4,74
EQUITIES	Europe (ex-UK)			-10,0
	Usa			-10,0
	Japan			16,0
	UK			-10,0
	Emerging			6,0
CORPORATE BONDS	fixed rate USD AAA/A			1,6
	fixed rate USD BBB/B			0,0
	fixed rate Euro AAA/A			2,3
	fixed rate Euro BBB/B			1,8
EMERG. GOV'MNT BONDS	USD BBB/B			4,2
	Euro BBB/B			4,2
GOVERNMENT BONDS	fixed rate 7-10 years USD			4,2
	fixed rate 7-10 years Euro			4,2
	fixed rate 7-10 years Yen			0,8
	fixed rate 7-10 years Chf			1,5
CASH	euro libor 1 month			1,1

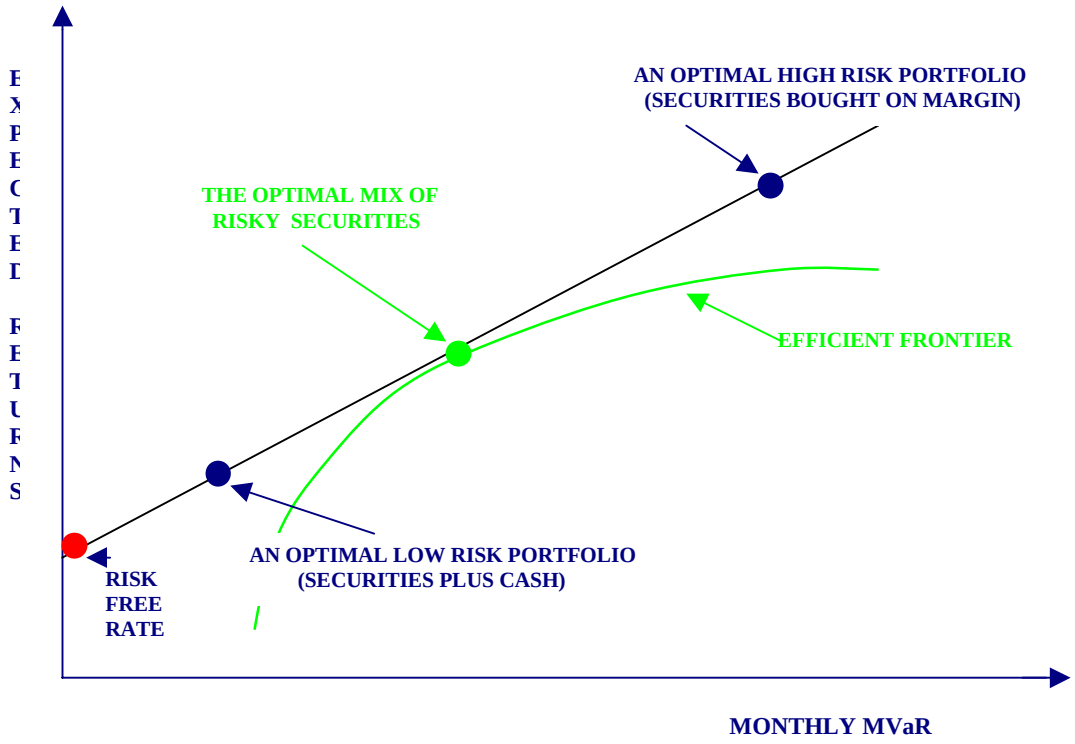
TABLE 4

SUMMARY OF JAN 00 – JAN 04 DATA

		SHARPE RATIO rfr 2.1 %	MEAN MONTHLY RETURN	MONTHLY STANDARD DEVIATION	SKEWNESS	EXCESS KURTOSIS	MONTHLY MODIFIED VaR 99%
Convertible arbitrage		2,82	1,11	1,24	-0,72	1,98	3,41
Dedicated Short		-0,21	-0,14	5,16	0,42	-0,31	13,19
Emerging Markets		0,69	0,76	3,13	-0,68	0,09	6,40
Equity Mkt Neutral		3,78	0,77	0,58	0,54	-0,16	0,83
Event Driven		1,90	0,79	1,20	-1,23	2,47	2,77
Distressed		1,76	0,92	1,57	-1,08	2,37	3,65
E.D. Multi Strategy		1,81	0,76	1,19	-0,42	2,32	2,78
Risk Arbitrage		1,13	0,52	1,12	-0,60	1,96	3,04
Fixed Income Arbitrage		2,08	0,58	0,71	-1,70	4,45	2,28
Global Macro		2,33	1,24	1,72	-1,14	3,88	5,22
Long/Short Equity		0,22	0,34	2,76	0,87	4,78	5,85
Managed Futures		0,65	0,83	3,73	-0,02	-0,18	8,21
Multi Strategy		2,64	0,78	0,84	-0,49	0,71	1,52
EQUITIES	**Europe (ex-UK)**	-0,53	-0,89	6,62	-0,09	0,48	18,25
	Usa	-0,39	-0,40	5,05	0,01	-0,62	12,69
	Japan	-0,65	-0,97	5,80	-0,07	-1,28	9,40
	UK	-0,71	-0,82	4,63	-0,32	-0,11	13,26
	Emerging	0,07	0,29	6,42	-0,34	-0,42	14,65
CORPORATE BONDS	**fixed rate USD AAA/A**	1,64	0,79	1,38	-0,92	2,39	4,22
	fixed rate USD BBB/B	1,33	0,75	1,60	-0,36	0,55	4,28
	fixed rate Euro AAA/A	1,51	0,53	0,85	0,02	-0,32	1,53
	fixed rate Euro BBB/B	1,18	0,50	0,99	-0,51	1,39	2,63
EMERG. GOV'NT BONDS	**USD BBB/B**	1,36	1,22	2,89	-0,42	-0,19	6,61
	Euro BBB/B	0,87	0,79	2,62	-0,53	2,54	7,71
GOVERNMENT BONDS	**fixed rate 7-10 yrs USD**	1,22	0,81	1,91	-0,97	1,91	5,29
	fixed rate 7-10 yrs Euro	1,27	0,61	1,24	-0,34	-0,24	2,37
	fixed rate 7-10 yrs Yen	0,29	0,25	1,00	-1,78	5,44	3,59
	fixed rate 7-10 yrs Chf	0,82	0,44	1,19	0,10	-0,30	2,35
CASH		n.a.	0,17	n.a.	n.a.	n.a.	n.a.

APPENDIX A

EFFICIENT FRONTIER AND OPTIMAL PORTFOLIOS



An Investor's portfolio should be located on the straight line between the Risk Free Rate intercept (red spot) and the Optimal Portfolio (green spot) and, while moving further to the right, on the efficient frontier curve (green line), as we assume borrowing is not allowed.
The position along the path is only a function of the risk tolerance of the Investor (the two blue spots are examples of optimal portfolios, with the one to the right in case borrowing were allowed).

APPENDIX B

In this paper we have applied the Modified-Value-at-Risk (MVaR) model on two different periods; for the same periods and with the same set of data we have also applied the classic Mean-Variance model to compare the two outcomes. Below the relevant results are summarized:

Period from 1994 through 2000

Optimal Portfolios:

	ANNUALIZED EXPECTED RETURN	MONTHLY VaR 99%	MONTHLY STANDARD DEVIATION	S&P500 %	HEDGE FUNDS %
M-VaR	9,4	2,6	1,4	20	80
MEAN-VARIANCE	11,4	3,5	1,9	40	60

with following strategies and weights:

M-VaR: **MARKET NEUTRAL 52%, LONG/SHORT 14, GLOBAL MACRO 14%**

Mean-Variance: **MARKET NEUTRAL 23%, LONG/SHORT 15%, DISTRESSED 13%, GLOBAL MACRO 9%**

The weights are quite different and in particular the M-VaR optimal portfolio is much less risky then the Mean-Variance's one.

It is interesting to notice that with a portfolio expected return of 11,4 % (the optimal of the Mean-Variance model) the M-VaR model has a VaR of 4,35% (not shown): this means that the 2 moments model does not represent the complete risk structure of the portfolio.

Period from 2000 through 2004

Optimal portfolios:

	ANNUALIZED EXPECTED RETURN	MONTHLY VaR 99%	MONTHLY STANDARD DEVIATION	GOV'T BONDS %	EQUITY JAPAN %	HEDGE FUNDS %
M-VaR	9,8	0,4	0,7	42	4	54
MEAN-VARIANCE	12,2	0,8	0,8	27		73

with following strategies and weights:

M-VaR: **CONVERTIBLE ARBITRAGE 18%, MULTI STRATEGY 14%, EMERGING MARKETS 10%, EQUITY MARKET NEUTRAL 9%, DISTRESSED 3**

Mean Variance: **MULTI STRATEGY 33%, DISTRESSED 29%, GLOBAL MACRO 7%, EMERGING MARKETS 5%**

Furthermore a simulation using the same set of data but adding back to the expected returns the full bias impact recommends an allocation of almost 100% to hedge funds.

The preliminary conclusion is that the shape of the distribution is important but the results (the best mix of asset classes) are by far determined by two other factors:

- bias adjustment
- expected returns

The bias adjustment we have introduced has such an impact on returns to become a fundamental element in the optimization process.
The expected returns relevance is not something new and from this study we have the confirm that any portfolio definition in a context of dynamic allocation is heavily influenced by their forecast, net of biases.
Asset managers, in their allocation process, should then focus mostly on the crucial factors shown above when trying to maximize the risk-return trade-off.
It should be noted that the two models suggest different asset allocation but most important they show a difference in portfolio risk as measured by the Modified VaR model with respect to the Mean-Variance model: in a global risk management procedure this factor should be accounted for.