

Risk Management for Multi-Manager Portfolios of Alternative Investment Strategies

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Abstract:

A general discussion of risk management issues related to Alternative Investment Strategies (hedge funds and managed futures) is presented. The distinct risk types in the diverse investment strategies universe are illustrated from the perspective of a multi-manager fund. A three-pillar approach for risk management of AIS portfolios is suggested. Particular emphasis is given to "post-investment" risk management, for which an overview over the different risk analysis tools available to the multi-strategy fund manager is provided.



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I. Introduction

It is well known in today's investment community that, if properly included in a global portfolio, Alternative Investment Strategies (AIS) can enhance return and reduce the risk of a global investment portfolio. Improperly used, though, AIS can create an investment disaster. Evaluating the "risk dimension" is therefore critical to the proper use and management of AIS. The challenges of AIS risk management are twofold: complexity and rapid change. Alternative investment strategies are much more complex and varied than traditional asset classes, and AIS risk management requires a thorough understanding of the many different underlying strategies. Yet these strategies are changing even as investment professionals and risk managers struggle to understand them. To make matters worse, the overall risk management practices of the investment community are also rapidly changing across all asset classes. The "state of the art" in financial risk management has developed dramatically over the past few years, with new paradigms and ever more complex models emerging. Despite these challenges, active risk management adds tremendous value to the investment and asset allocation process of AIS investors and managers.

In recent years, Alternative Investment Strategies (AIS)¹ have proliferated at a remarkable pace. Along with asset growth has come a change in the investor base. Until recently, investors in AIS have mainly been wealthy individuals willing to invest in non-transparent funds ("black box investing"), as most AIS trading managers disclosed neither their strategies nor their individual positions. New investor demand along with improved technology and increased manager talent attracted to the industry have changed the face of AIS. Due to the attractive risk-reward characteristic of AIS funds as well as their low correlation to traditional asset classes, institutional investors have recently become more and more interested in AIS. This new type of investor with fiduciary responsibility has a very different risk profile and investment philosophy than the high net worth investor (institutional investors tend to have a rather long term view, higher risk aversion, and emphasis on stability in investment returns, while high net worth individuals are more short term focussed, are less diversified and more accepting of higher volatility). Thus, AIS managers are now faced with demands for increased investment transparency, higher liquidity, and more sophisticated risk management.

Hedge fund debacles during the market crisis of 1998 (e.g. LTCM) and periodic reports of other hedge fund "blow ups" and fraud (e.g. "Manhattan Hedge Fund" in spring 2000, "Maricopa" and "HL Gestion" in the fall of 2000) have added to investor concerns about the lack of transparency and inherent "credit risk" (i.e. specific manager risk) of their investments in AIS. We judge risk management to be a key factor in determining the quantum of further inflows from institutional investors into the AIS industry, for without effective risk control, we believe pension funds and other institutional investors will resist increasing allocations to AIS. Several recently

¹ We classify AIS into two different categories: Hedge funds and futures strategies (see Fig. 1). Although there is neither a unique definition for hedge funds nor futures strategies, AIS are generally referred to as "skill based" strategies, where investment returns are a function of particular skills of the individual trading manager. This contrasts to investments where returns are mostly generated by broad market moves.

performed surveys by Capital Market Risk Advisors², the Investor Risk Committee, and the Hennessee Hedge Fund Advisory Group³ indicate that hedge fund managers are growing more aware of the importance of risk management practices⁴. One of the leading journals for Alternative Investing, the "HedgeMar" magazine, dedicated the cover story in their Dec. 2000 edition to the transparency issue, where the increase in demand for transparency and risk management was outlined.

Due to the technical complexity of AIS (spread strategies, leverage, short selling, investments in a variety of different asset classes and instruments) risk management has become one of the most important elements (and most difficult challenges) of the investment process. We are convinced that third party risk management adds good value to the investment process in multi-strategy funds, as will be elaborated in this article. An increasing number of multi-manager funds of AIS (fund of funds) have emerged specializing in finding the most interesting and best performing trading advisors while eliminating the traditional "manager risks" of AIS investing. Along with this, a new dimension of transparency is developing, liquidity standards are improving, and with the recent institutionalisation of the AIS industry has come the debate over the appropriate approach to risk management.

Despite the growing investor awareness of the importance of transparency, there remains a surprising degree of resistance to such transparency in the AIS industry. Regarding multi-manager AIS investments we would like to contrast the "black box investing approach" with a new emerging paradigm, and we will name this the "transparency paradigm". The transparency paradigm is characterized by the following:

- Detailed understanding of the individual managers' strategies and their risks
- Complete transparency of the positions of each individual manager in the portfolio (the aggregated portfolio exposure, but not the individual managers' positions, being frequently communicated to the final investor)
- High investment liquidity (most, but not all, AIS managers trade instruments that are traded on public exchanges that offer daily liquidity)
- Systematic and continuous monitoring of open positions and measurement of risk
- Active management of risk

From the viewpoint of risk management and investment control, three essential elements of the investment process in AIS have to be considered, where the first two elements represent the "pre-investment risk management" of the investment process, and the third element is considered "post-investment risk management":

1. Sector allocation (top down): Allocation of capital to different AIS sectors.

² Can be found under http://www.cmra.com/html/hedge_fund.html.

³ See under http://www.hedgeworld.com/news/read_news.cgi?story=strt410.html§ion=strt

⁴ A group of five Hedge Fund Managers including Soros Management LLC issued the report "Sound Practices for Hedge Fund Managers" in February 2000 as a response to the President's Working Group report on financial markets after the collapse of Long Term Capital Markets ("LCTM"), see footnote 8.

This requires good knowledge and understanding of the strategies, in general, and the general risk factors and risk levels of the individual sectors, in particular. This should be brought in line with the investor's risk profile. The goal is to invest in the right market sector at the right time, and to achieve the appropriate level of diversification.

2. Manager evaluation (bottom up)⁵: Detailed examination of the individual trading manager's strategy and a thorough due diligence process (qualitative and quantitative).

The strategic edge and competitive advantage of the individual trading manager should be understood in great detail, the firm's structure should be well known, and key personnel should be examined for integrity.

3. Continuous monitoring / risk assessment: Daily P&L, exposure and risk characteristics of the portfolio.

This enables the risk manager to quickly identify potential style drifts (i.e. a different strategy than formerly indicated is being followed by the trading manager) and undesired market bets, which do not match the risk profile. Leverage controls and risk limits can be implemented and enforced efficiently (e.g. VaR and leverage limits). The investment manager's understanding of the strategy should match the strategy's actual P&L and exposure profile in different market situations.

We refer to these three elements as the "three dimensions of active risk management in AIS investments." Our intent is to emphasize the importance each one of these elements plays in an appropriate risk management structure.

The different types of risk in AIS investing are presented in section II. In section III, the three dimensions of risk management are further elaborated. Finally, section IV describes the different quantitative tools available to the investment manager for the monitoring and managing of different risks.

II. Different Risks in Alternative Investment Strategies

In addition to describing the risk structure of different strategies in this section, we also look at risk from the perspective of an investor who must make fund allocations.

Risk profile of the different strategy sectors:

The universe of liquid AIS (excluding e.g. private equity and real estate investments) can be divided into two main categories (see footnote 1 and Fig. 1): Hedge Funds and Managed Futures. Managed futures are investment entities (e.g. private pools and public funds, managed accounts), which take long, and short positions in exchange traded derivatives (futures and options). Hedge funds use a wide variety of different asset classes for the implementation of directional or non-directional

⁵ We refer to the individual managers exercising a particular trading strategy as "trading manager". The multi-strategy manager is referred to as "investment manager".

investing strategies. Hedge fund managers hold long and short positions and sometimes use significant leverage.

Fig. 2 presents the risk-return profile of the individual hedge fund sectors and futures strategies based on past performance⁶. The inherently different nature of AIS as compared to traditional investments and the diversity within the AIS universe itself forces the risk manager to consider a variety of risk types for the individual strategy sectors. Among those, we distinguish

- Market risk (risk of loss due to moves in the market value of the holdings)
- Credit risk (risk of counter-parties defaulting on their obligations)
- Liquidity risk (risk of decline in liquidity reducing the value of the investment or the ability of the fund to fund its investment)
- Operational risk (risk of failure of internal systems, technology, people, external, or physical events)
- Diversification risk (risk of unforeseen correlation breakdown)
- Model risk (risk of an incorrect valuation of a financial instrument⁷)
- Corporate event risk (risk specific to a particular firm)
- Fraud risk
- Legal risk (risk of not being able to enforce legal claims)

The amount and type of investment risk can vary substantially among different strategies. While for instance Global Macro, L/S equity, currency strategies, short sellers, and the different futures strategies are strongly exposed to market risk, credit risk is the major risk for Distressed Securities and Convertible Debenture Arbitrage strategies. Relative Value (in particular Risk Arbitrage), Event Driven strategies, and Distressed Securities strategies are significantly exposed to corporate event risk, while liquidity risk can become a major problem for Fixed Income Arbitrage as well as distressed securities investments.

Since many strategies rely heavily on quantitative modeling, most of them are exposed to model risk. Legal risk is an important consideration in private placement (convertible debenture arbitrage) and distressed securities investments. Finally, fraud risk is an inherent risk in all types of investments. As many of these risks are related to each other, one of the most challenging aspects of the multi-strategy investment process is to identify the specific risks of the individual strategies and the interrelation of these risks.

The following list presents the specific risks that the different strategies are exposed to in detail:

Global Macro: This strategy is based on making (leveraged) bets on anticipated price movements of stock markets, interest rates, foreign exchange rates and commodity prices. The main risk of this strategy is the trading manager's inability to predict market moves (which has become increasingly difficult) and is therefore mostly market risk. To the degree that the trading manager trades in OTC derivatives, the strategy also becomes exposed to liquidity risk.

⁶ Data source: Hedgefund Research and Mar, Jan. 1990 - June 2000.

⁷ This risk is sometimes classified as operational risk, but in our context we see it as its own risk type.

Hedged (L/S) Equity: This strategy consists of investing in a core holding of long equities hedged with short sales of particular stocks and/or stock index derivatives. A first risk is lack of stock picking ability of the trading manager (on the long as well as on the short side). Secondly, the determination of the net exposure to the market (long or short bias) requires the trading manager to perform some directional market forecasting. Correlation to the broad equity market (or particular sectors) is generally rather high, so the strategy bears the general market risk of equity investments. Additionally, the strategy is exposed to corporate event risk in its individual holdings, model risk (if quantitative evaluation is used for stock selection), and liquidity risk (for small cap stock investments). Many trading managers hold a very high number of positions simultaneously, so the strategy can bear significant operational risk. Sudden changes of correlation can also lead to diversification risk.

Equity Market Timing: This strategy allocates assets by switching into equity positions that show the beginning of an upward trend. The process consists primarily of switching between equity sector mutual funds and money market funds. The main risk of this strategy is a sudden adverse move by the equity market (sector). The strategy is exposed to market risk whenever positions are taken upon a signal. Operational risk is present due to the daily switching within different mutual funds.

Relative Value: This strategy attempts to take advantage of relative pricing discrepancies between different markets (equities, debt, currencies, and commodities) using a variety of different instruments such as options, futures, swaps, warrants, convertibles, etc. Among the Relative Value strategies four different types can be distinguished.

1. *Fixed Income Arbitrage:* Investments are made in fixed income instruments with generally little exposure to interest rate changes. In most cases the strategy holds spread positions between very similar instruments (e.g. T-bill versus Eurodollar, instrument with different duration, instruments with different credit rating). In order to earn attractive returns, most strategies must employ a high level of leverage. The main risk is the sudden breakdown of historical correlation patterns between the different fixed income instruments. This can occur due to changes in government policy, sovereign default (Russia in August 1998), and other events. These events occur relatively infrequently (tail risk).

Many strategies involve trading credit spreads, and therefore carry a significant amount of credit risk. Liquidity can become a very important risk, as the failure of Long Term Capital Management in Aug./Sept. 1998 provides an illustrative example of this ⁸. As many trading managers employ quantitative models to find pricing discrepancies in different markets, they are exposed to model risk, and the large number of different positions held leads to significant operational risk.

2. *Risk Arbitrage:* This strategy involves investment in event-driven situations such as leveraged buy-outs, mergers and hostile takeovers. The main risk is obviously corporate event risk. Liquidity risk can be quite important for small cap risk arbitrage. In times of volatile markets the deal flow of announced merges can

⁸ "Hedge Funds, Leverage, and the Lessons of Long-Term Capital Management," Report of the President's Working Group on Financial Markets, April 1999; P. Jorion, "Risk Management Lessons from Long-Term Capital Management," European Financial Management, VOL 6:3 September 2000.

decrease rapidly, thus constraining the trading manager in quality and quantity of possible investments.

3. *Convertible Bond Arbitrage*: This strategy attempts to take advantage of relative pricing discrepancies between an undervalued convertible bonds and the equity of the issuing firm. The value of the inherent option of a convertible bond is hedged with a short position in the stock (or a corresponding option position on the stock). Convertible bond arbitrage strategies are mostly exposed to credit and corporate event risk. To the extent quantitative pricing models are used, the strategy bears model risk. The financial market crisis in 1998 has shown that this strategy can be exposed to significant liquidity risk in times of volatile markets. Market risk is an important risk factor, as a long option position and a short hedge in the underlying stock is effectively a "long volatility" position.

4. *Equity Market Neutral / Statistical Arbitrage*: Equity Market Neutral and Statistical Arbitrage managers strive to generate returns in both bull and bear markets by selecting positions with a total net exposure of zero. This neutrality can be established in terms of dollar exposure, beta exposure, exposure to sectors, industries, and other risk factors. The strategy is exposed to (market) risk factors which it does not specifically target a zero exposure for. Trading in small cap stocks can lead to liquidity risk. Some managers exclude all discretionary elements from the decision making process, and this complete lack of qualitative elements distinguishes Statistical Arbitrage strategies from the broader category of Equity Market Neutral strategies. The extensive use of quantitative models introduces a high degree of model risk to the strategy. Sudden changes of correlation can also lead to diversification risk (i.e. breakdown of price and correlation pattern observed in the past. This happens especially in very volatile market environments).

Event Driven (sometimes referred to as "corporate life cycle" investing): This strategy involves investing in opportunities created by significant transactional events, such as spin-offs, bankruptcy reorganizations (see "Distressed Securities" below), re-capitalization and share buybacks. The portfolio of an Event-Driven manager may shift between Risk Arbitrage and Distressed Securities, or it may take a broader scope. The risk profile of this strategy is similar to the risks within Risk Arbitrage and Distressed Security investing: Corporate event risk, liquidity risk, and legal risk.

Distressed Securities: This strategy is a particular "Event Driven" strategy. It involves investing in the securities of companies where the security's price has been, or is expected to be affected by a situation of distress, like the risk of near-term bankruptcy, liquidity problems, etc. The value of the investment depends mostly on the specific situation of the company and the instruments are not traded very heavily, so the main risks of this strategy are corporate event risk and liquidity risk. Legal questions become important once insolvency procedures are initiated (in the U.S. this usually proceeds under Chapter 11 of the corporate bankruptcy law), so the strategy is heavily exposed to legal risk.

Convertible Debenture Arbitrage: Convertible Debenture Arbitrage managers purchase privately placed unregistered convertible securities from publicly listed companies (AMEX, NASDAQ, etc.). Investments are made pursuant to an exemption

from registration as provided by Regulation D of the SEC Act of 1933. Due to the private nature of the transaction, significant risk arises from legal issues and lack of liquidity. Other important risk factors of this strategy are credit risk (default) and corporate event risk. Most Convertible Debenture Arbitrage managers aim at eliminating market risk by correspondingly hedging the debenture with the publicly traded stock.

Currency Trading: Currency managers engage in speculative trading in foreign exchange markets. This strategy's risk profile is dominated by market risk. Possible quantitative modeling exposes the strategy to model risk.

Short Selling : This strategy involves the sale of a security not owned by the seller; a technique used to take advantage of an anticipated price decline. The main risks of this strategy are market risk (the strong bull market of the 90s has made this strategy consistently the worst performing hedge fund sector in the last ten years) and corporate event risk (unexpected good news, takeovers, split-ups involving the companies sold short).

Systematic Passive Futures Strategies: This strategy passively mimics the hedging patterns of commercial "natural longs and shorts" by systematically taking the opposite side/position of the commercial hedgers in futures markets. Examples for this strategy are the MLM index and the saisGroup Futures Index⁹. Market risk is the dominant risk factor for this strategy, in particular in a non-trending, directionless market environment with continuous price reversals.

Active Futures Strategies (systematic and discretionary), CTAs: Within this sector, proprietary computer models or discretionary approaches generate buy and sell decisions employing futures contracts. As for systematic approaches, market risk is the dominating risk of this strategy. To the extent quantitative models are used, modeling risk (in particular curve fitting and over-optimization) becomes part of the risk profile of this strategy, and because a large number of simultaneous positions are taken, operational risk becomes an issue.

Long Only Futures Strategies: A certain benchmark for commodity investment is replicated (e.g. Goldman Sachs Commodity Index (GSCI) or Commodity Research Bureau Index (CRB)). This rather simple strategy is exposed to the market risk of the underlying markets.

The different strategies fall into three different groups in terms of risk:

1. *Low risk:* Lower risk strategies including Equity Market Timing, Relative Value strategies, and Systematic Passive Futures strategies. Some hedged (long/short) equity strategies also fall into this low risk category.
2. *Medium risk:* Convertible Debenture Arbitrage, Fixed Income and Convertible Arbitrage, Equity Market Neutral and Statistical Arbitrage as well as Event Driven strategies can be considered as strategies with moderate risk.

⁹ A detailed description of this type of strategy is presented in M. Jacquemai, P. Cittadini, L. Jaeger, "The saisGroup Futures Index (sGFI) – A New Passive Futures Investment Strategy," saisGroup Research Paper, see <http://www.saisgroup.com>

3. *High risk*: Most Hedged equity strategies, Global Macro, Currency Trading, Short Selling, Active Futures (CTAs) and Long Only Futures Strategies can be classified as high-risk strategies.

Market risk, credit risk and liquidity risk

While it is current practice to consider market and credit risk separately, it is increasingly argued¹⁰ that risk management should consist of assessing the three interrelated risks (market, credit, and liquidity risk) in combination.

The risk factors influencing *market risk* are

- Level and shape of interest rate term structures
- FX rates
- Equity prices
- Commodity term structures
- Credit spreads
- Nonlinearities related to derivatives
- Volatilities
- Correlation

These risks should be evaluated for the individual parts of the portfolio (e.g. strategy sector, asset class, instrument, geographic region) as well as for the portfolio in aggregate. It should be possible to identify the market risk assumed by each trading manager.

Liquidity risk is the potential change of the asset due to tight liquidity of the market in which the asset is traded. This can be measured by either the number of days it takes to liquidate the position or by the potential loss related to the immediate sale of the asset. Furthermore, funding liquidity risk is critical to the fund's ability to continue trading during stresses. Ongoing levels of liquidity should be measured and assessed relative to the risk level of the fund.

Credit risk is the uncertainty surrounding a firm's ability to serve its debt. Assessing credit risk means identifying counter parties as acceptable based on an analysis of their creditworthiness and continuous monitoring of the same. This analysis of exposure to particular counter parties should include

- Current replacement costs (current exposure)
- Potential exposure (additional exposure due to changes in the market value of the exposure)
- Probability of loss
- Loss given default
- Risk mitigation (netting procedures, collaterals, credit enhancements)

III. Risk from the original investor's view

The (institutional and private) investor usually looks at risk from a broader perspective. From his viewpoint, four general categories of risk of AIS can be

¹⁰ See also: "Sound Practices for Hedge Fund Managers", February 2000 (footnote 4)

identified. They are listed below in order of least to most impact on the investor's portfolio.

1. *Inappropriate fund allocation* (procedural mistake before investing): Investing in the wrong asset classes/strategies/instruments leading to inappropriate risk/return profile for the investor.

This type of risk can be limited through thorough analysis and investigation of the trading managers and his strategy after appropriate investment objectives and risk parameters have been set.

2. *Under-performance* : Performance less than objective.

This is a natural investment phenomenon that can be reduced through a thorough due diligence and allocation process picking the best trading talents. The risk is real and cannot be entirely eliminated

3. *Severe decline* in account value: Sharp, significant drop in value.

This can be caused by

1. A deviation from strategy (style drift or an unexpected "bet" of the trading manager)
2. A lack of understanding of the risks involved / Occurrence of a previously unknown risk, mostly a price move never experienced before (e.g. bonds spreads with LCTM in Aug. 1998)
3. A risk that was known and accepted as part of the investment strategy.

In order to cope with this risk, which is (besides fraud) most feared by investors, continuous monitoring of positions, exposure, and risk is necessary. In addition to allowing for the early recognition of deviations from a strategy and the identification of individual (and undesired) "bets", continuous exposure and risk monitoring can also help detect previously unknown risks (particularly in extreme market environments).

4. *Fraud* : This is a risk in any investment, but due to the specific focus on individual trading managers and the participation in a private and mostly unregulated investment vehicle; this risk is quite significant for investments in AIS. Exposure to fraud is the ultimate nightmare for investors. A good safeguard is to know the individuals involved and to check every detail of their background. Probably the best way to safeguard against this risk is to separate the trading manager from the money (managed account in the name of client or fund). In addition, continuous monitoring of the manager's trading activity decreases this type of risk considerably.

IV. The three dimensions of active risk management in AIS investment

A well-constructed AIS portfolio can add tremendous value to a traditional investment portfolio composed of mainly equities and bonds. As described in the previous section, different AIS can be complex in their risk structure, and in order to account for this complexity, the construction and maintenance of a multi-strategy portfolio demands high discipline and consistency. We consider three fundamental pillars as the basis for such an approach (see Fig. 3):

1. Strategy allocation: Identification and selection of AIS sectors.
2. Manager evaluation: Thorough analysis and due diligence process
3. Investment monitoring and risk management

Each one of these three elements has unique importance in the investment and risk management process. We refer to the first two points as “pre-investment risk management.” The third pillar, “post investment risk management,” which we see as requiring particular emphasis, is most often neglected and its importance underestimated.

1. Strategy allocation (top down approach): The correct overall allocation to the different strategy sectors is the key performance driver within a multi-strategy portfolio. Return and risk properties of the portfolio are very sensitive to the sector allocation within the portfolio. As is generally the case for investment portfolios, diversification is the key element of the portfolio allocation process, and following modern portfolio theory we identify correlations as the most important determinants for diversification¹¹. Quantitative optimization can be quite useful in determining the scope for improvement from adding AIS to a global traditional balanced portfolio. However, it is not a good tool for determining the allocation of different AIS in the multi-manager portfolio. The results of a Markovitz type optimization are too sensitive to the return and risk assumption used in the calculation. Return and risk properties of the individual strategies vary substantially over time and in different market environments.

The following list constitutes important steps to successfully create a good sector allocation within the portfolio:

1. *Analyzing general attractiveness of a strategy sector:* The risk-return profile of the sector should be examined and the general edge (competitive advantage) of the strategy sector should be assessed.
2. *Assessing potential risks:* The particular risks of the sector should be understood, and measures for risk control should be determined.
3. *Estimating past and anticipating future correlations:* Correlation is the key factor for diversification (and therefore optimal risk-return ratios) within a

¹¹ For a discussion of diversification within a multi-strategy portfolio, see: J. Park and J. Strum, “Fund of Fund Diversification: How much is enough?” The Journal of Alternative Investments, Winter 1999. See also R. McFall, “Portfolios of Alternative Assets: Why not 100% Hedge Funds?” The Journal of Investing, Winter 1999, p. 87-97.

portfolio. The correlations between the different strategies as well as the individual strategy's correlation to other asset classes (i.e. bonds and stocks) should be evaluated. Furthermore, the necessary number of individual trading managers needed to reach sufficient diversification within one strategy sector is an important consideration.

4. *Assessing market environment*: It is important to understand the general behavior of the strategies in different market environments. Favorable and unfavorable market environments should be determined and analyzed. Additionally, the analysis of conditional correlations of the strategies demonstrates the overall portfolio's sensitivity to extreme market moves.

These considerations should be seen in the context of the client's risk profile, liquidity requirements, home currency, and tax status. Internal legal constraints (concerning e.g. short positions) are also important. It should be finally noted that the sector allocation process is not terminated with the initial investment but requires ongoing monitoring and reassessment.

2. Manager Evaluation (bottom up approach): Trading managers within a sector differ with regards to strategy implementation, investment diversification, portfolio and security hedging, use of derivatives, and the degree of leverage. A thorough due diligence of each individual manager should be, without any exception, a pre-requisite of any investment. Note that there are qualitative and quantitative aspects to the due diligence process. Quantitative examinations include the analysis of performance (return, volatility, drawdown, Sharpe ratio, etc.) and correlations. Important qualitative aspects ("soft factors") are, among others, character, quality and background of the people, business concept, decision-making process, trading facilities and operations.

The due diligence should cover in detail the following three areas:

1. Investment Analysis (Seven P's):
 - a. People: The background and integrity of key personal should be examined.
 - b. Partnership: The firm's legal and incentive structure has to be clear (Is the trading manager investing his own money?). An assessment of the business risk of the firm should be made.
 - c. Process: An important question is how investment decisions are made within the firm (including risk management).
 - d. Performance: The sources and economic reason for returns and risks of the investment strategy should be understood. The particular edge of the trading manager has to be clear¹². Quantitative analysis of the track record is an important part of the performance evaluation process.
 - e. Portfolio: The way the trading manager manages his portfolio (sub-strategies/different asset classes) is an important consideration.
 - f. Peers: The manager should be compared within his peer group (strategy sector). His uniqueness and correlation with his peers should be examined.
 - g. Potential: The maximal \$ capacity of the strategy should be known.

¹² We distinguish two types of edges: Edges are either informational or statistical. Note that an edge sometimes disappears over time as other market participants will adopt/copy a proven strategy.

2. Risk Management performed by trading manager:

- a. The investment manager needs to know the trading manager's internal risk management procedures, e.g. stop loss limits, portfolio diversification, hedging, etc.
- b. All possible risk factors of an individual strategy should be listed in a detailed risk catalogue.

3. Market Environment:

- a. A favorable and unfavorable market environments for the strategy should be known.
- b. A benchmark for the trading manager's performance is very helpful.

3. Investment monitoring and risk management: In order for investment monitoring and risk management to be performed successfully, profound knowledge of the individual strategies is required prior to an investment. In attempting to evaluate where the current and future risks are, risk management should be proactive. Analysis of past data is only one part of the process. While one might learn a good number of lessons from the past, it is almost certain that risk factored not encountered before will emerge. Continuous monitoring of positions, P&L, and risk leads to:

1. Dynamic understanding of the strategy and the manager's behavior in various market circumstances. The application of the strategy is followed and continuously evaluated in real time in different market environments (continuous extension of the due diligence process).
2. Detection of previously unknown (or unrecognized) risks in the investment strategy, if any (sudden "style drifts").
3. Quick recognition of style changes, undesired "bets", and increase of leverage employed by the manager (shown by increase in risk within certain asset classes and instruments).
4. A decrease in probability of fraud risk.
5. The possibility of trading manager control, risk management (e.g. de-leverage) and risk adjusted (re)allocation within the portfolio.

It should be emphasized that this "post-investment risk management" requires *full transparency* down to the individual positions within each trading manager's portfolio. The most efficient way to achieve transparency is through a "*managed account*", where the trading manager has no direct access to the investor's funds. Rather, he has authorization to trade the account while the money physically remains with the prime broker of the multi-strategy allocator. The daily positions of the portfolio are downloaded from the prime broker. Besides enabling the multi-strategy manager to perform his monitoring task, managed accounts drastically reduce the risk of fraud.

Managing risk is not just measuring the risk inherent in the portfolio; it entails using measures to dynamically allocate risk optimally among different assets and

managers. Within an active risk management approach, there are various ways to impose risk limitations on the trading managers within the portfolio:

- I. Regular conversations with the trading manager and discussions regarding the current and recent risk profiles.
- II. Request for explanations about unusual positions
- III. Strict risk limits ("risk buckets") that, once exceeded, automatically lead to a re-allocation within the portfolio. Examples are limits on risk (VaR limits) for the global portfolio/individual sectors or notional exposure limits to particular sectors.
- IV. Imposing margin requirements (leverage control).
- V. State-of-the-art risk management tools are necessary in order to perform these types of risk monitoring and management effectively

V. Elements of Post-Investment risk management

In this section different quantitative tools available to risk managers are presented: Exposure analysis, correlation, Value at Risk and its different variations, stress testing, scenario analysis, extreme value theory and credit risk models.

State of the art risk management tools are necessary in order to perform these types of risk monitoring and management effectively.

Exposure analysis. Risk is a combination of exposure and uncertainty. Besides aggregate exposure on the level of the global portfolio, the analysis should include a breakdown of the exposure to different aggregation levels. Part of the exposure analysis is the monitoring of the margin characteristics and leverage factors on the level of individual trading managers. Fig. 4 shows an example of an exposure analysis for the equity part of a multi-strategy portfolio.

Correlation and volatility analysis of risk factors. Volatilities and correlations should be analyzed on different aggregation levels: Global portfolio, instrument sectors, and individual trading managers. For the calculation of correlation and volatilities, the literature offers a rich universe of methods¹³.

Value-at-Risk (VaR). VaR is the most widely used quantitative measurement tool for risk analysis. It describes the maximal loss from an adverse market move within a specified confidence level (e.g. 95% or 99%) over a specified trading horizon (e.g. 1 day or 5 day). Mathematically speaking, it characterizes the extreme quantile of a return distribution. Despite a number of pitfalls (see below), VaR has actually introduced a new dimension of risk analysis to the financial community. 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. As VaR reflects some, but unfortunately not all, information about the extreme left tail region of the distribution, it has to be

¹³ For a good overview, see J. Hull, "Options, Futures, and other Derivatives," Fourth Edition, Prentice Hall (1999), Chapter 13. The ARCH/GARCH approach is well covered in the review paper: T. Bollerslev, R. Chou, K. Kroner, "Arch modeling in finance," Journal of Econometrics, 52, p.5-59 (1992).

supplemented with other measures in order to give a complete picture of risk in the investment portfolio (conditional VaR, stress tests, scenario analysis).¹⁴

VaR should be based on an analysis of every important risk factor in the portfolio. Note that the number of risk factors can be quite large (>1000) including different yield curve points, commodity forward rate points (nearby contracts), equity indices, currency rates, etc. As for net exposure, VaR should be calculated on a variety of different aggregation levels within the portfolio (fund wide risk attribution, asset classes, sectors, instruments, trading managers, geographical regions). Three different methods to calculate VaR are distinguished:

- *Variance-based VaR* (parametric approach)¹⁵: Assuming normality of the risk factor distribution and a linear relationship between risk factors and portfolio positions, the return distribution of the portfolio is normal with the standard deviation determined by the covariance matrix and the exposure to the individual risk factors. The calculation of portfolio risk is based on conditional volatilities and covariances. The method has the charm of simplicity but is severely flawed in circumstances where linearity does not hold. The method is a "local valuation" method, as only the mark to market values of the portfolio positions themselves enter the valuation of the portfolio.
- *Monte Carlo VaR*: The behavior of the underlying risk factors is simulated through random draws for the returns of the underlying risk factors. The non-linearity of the relationship between instrument and risk factors is fully accounted for, as positions in the portfolio are fully revalued under each of the random scenarios. Every iteration step leads to a new valuation of the global portfolio. A high number of iterations (several thousand usually need to be performed) provide a simulated return distribution of the portfolio, from which the VaR value can be determined. The underlying distribution of the random risk factor returns can be chosen freely, but in most cases the simulation draws from a normal distribution.
- *Historical simulation VaR* (non-parametric approach): This method relies on the unconditional historical distribution of returns. The distribution of the portfolio returns is calculated by applying past asset returns to the present holdings in the portfolio. The positions in the portfolio are fully evaluated for each historical return.

Because of the nonlinear and complex positions present in most Alternative Investment portfolios, the variance-based method can be quite misleading and should therefore be avoided. Historical simulations are attractive as they make no distributional assumptions, but the results depend strongly on the historical period chosen for the analysis. The Monte Carlo method is the most reliable, but is also computationally the most intense method. Further, as long as normally distributed draws are used, the Monte Carlo method does not address the issue of non-normally

¹⁴ There exist numerous books and articles about VaR and its importance as well as its limitations in risk management. A good reference is K. Dowd, "Beyond Value at Risk," Wiley Frontiers in Finance (1998). Furthermore, the technical document of RiskMetrics is a valuable source of information: "RiskMetrics – Technical Document," Fourth Edition 1996.

¹⁵ This method is also referred to as the "RiskMetrics VaR" method (with a confidence level 95% and a one day holding period), although RiskMetrics now also offers Monte Carlo based and historical simulation VaR.

distributed asset returns. The dependence and correlation structure of non-normal multivariate distributions is still subject of intense research.¹⁶

Risk can be analyzed along two different dimensions:

1. Risk as a function of time: "How high is my risk level today as compared to the day/week/month before?" ("Risk Tracking").
2. Risk analyzed at different aggregation levels: "Where does the risk come from?" ("Drill-down of risk", e.g. equities, FX, etc.).

Fig. 5 shows an example of a VaR analysis for a portfolio, with VaR tracking and drill-down of VaR.

The problems of VaR: Beyond VaR: The major benefit of VaR is that it is based on a uniform and comparative risk measure across all different investment positions. This facilitates the investment manager's analysis of investments across different asset classes as well as the single trading manager's portfolio. There are certain aspects of risk that VaR cannot cover:

1. VaR measures potential losses that occur fairly regularly (e.g. once in 20 or once in 100 days). VaR does not provide any information about the expected size of the loss.¹⁷
2. VaR relies heavily on its particular assumptions. One major challenge in implementing VaR is the specification of the probability distribution of extreme returns. In most implementations a normal distribution for asset returns with stationary covariance matrix of risk factors is chosen. These can be good assumptions on some days and poor ones on other days (unfortunately, the latter are the days when VaR is most needed!). Stretching out beyond the normal distribution very quickly leads to intractable mathematical problems, as non-normal multivariate distributions are much more difficult to deal with.¹⁸

VaR does not help us to forecast and prevent unacceptable losses. It is undisputed among theoreticians and practitioners of risk management that VaR needs to be supplemented by other analysis tools suited to cope with extreme market conditions.

Variations of VaR: Besides VaR there are additional measures related to Value-at-Risk:

- *Incremental (and marginal) VaR:* Incremental (marginal) VaR expresses the amount by which the value of VaR is increased (decreased) upon inclusion (exclusion) of a particular position or sub-portfolio¹⁹. Incremental VaR can be

¹⁶ P. Embrechts, A. McNeil, D. Straumann, "Correlation and Dependency in Risk Management; Properties and Pitfalls," ETHZ Working paper (1998) see http://www.math.ethz.ch/~mcneil/pub_list.html. A shorter version appeared in the journal "RISK", May 1999: pages 69-71.

¹⁷ Conditional VaR, in contrast, does provide some estimate of that loss.

¹⁸ See footnote 16.

¹⁹ Note that standard VaR is not additive with respect to sub-portfolios or individual positions, i.e. the VaR of the sum of two positions can be larger than the sum of the individual two VaR values.

used for the evaluation of an individual trading manager or position affecting the risk structure of the portfolio.

- *Expected Shortfall (Conditional VaR)*²⁰: Expected shortfall is the conditional mean value of the portfolio (sub-portfolio, position) conditional on the portfolio loss exceeding a certain threshold (VaR). This risk measure is sub-additive.²¹

Stress tests: Stress tests make use of extreme stress scenarios in order to ascertain coverage of the impact of extreme price changes in the market. Such tests give insight to the portfolio behavior under extreme, but plausible market conditions. We distinguish three different groups of scenarios underlying stress tests:

- Historical scenarios (e.g. the stock market crash in 1987, emerging market crisis in 1998).
- General market scenarios (e.g. a drop of 15 % in the equity markets).
- Portfolio specific scenarios (e. g. extreme losses in particular positions in the portfolio, sudden change of correlations).

Systematic stress testing for market risk includes the following:

- Appropriate size shocks.
- Test asymmetries in return distribution.
- Test for correlation breakdown.
- Stressing different combinations of asset classes separately and combined.

The result of stress testing is the potential profit and loss (P&L) impact on the portfolio.

Scenario Analysis: Scenario analysis consists of applying pre-determined price changes to the positions making up the portfolio and working out the value change of the portfolio as a result of these price changes. Scenarios can be applied independently of each instrument/asset or in consideration of the entire portfolio's correlation structure.

Extreme Value Theory: Accurate prediction of extreme events is of central importance to risk analysis. Academics as well as practitioners in financial markets generally agree that financial risk factors are not normally distributed. They exhibit fat tails (i.e. extreme events are more likely to occur compared to what a normal distribution suggests). Most available tools for parametric VaR estimation, such as GARCH or RiskMetrics (which is asymptotically equivalent to an IGARCH model with no finite unconditional second moment²²), are designed to predict common volatilities, and therefore have poor tail properties. Even historical simulation is faced with sampling problems in the tails. In order to cover the fat-tailed distribution of financial risk factors (leptokurticity), a non-normal probability distribution is more appropriate to work with. Extreme Value Theory (EVT) provides the theoretical

²⁰ A good discussion of conditional VaR can be found in: S. Uryasev, Tyrrell Rockafellar, "Optimization of Conditional Value at Risk," under <http://www.ise.ufl.edu/uryasev/roc.pdf>.

²¹ See footnote 19.

²² For further details, see the technical document: "RiskMetrics – Technical Document," Fourth Edition 1996

background for the description of the asymptotic distribution of the tails of leptokurtic distributions.²³ After determining the tail properties of the data, the VaR can be estimated as a quantile of the underlying extreme value distribution.²⁴ Studies have shown that VaR calculated on the basis of an underlying EVT distribution is considerably higher than normal VaR²⁵. In other words, VaR calculated on the basis of standard volatilities and correlations severely underestimates the real risk.

Credit Risk: Particular AIS are especially subject to credit risk, e.g. Convertible Debenture Arbitrage strategies. Here, pre-investment risk management is especially important. Detailed knowledge of the individual company's financial standings is a prerequisite for investment in strategies exposed to credit risk.

Prior to default, there is no way to distinguish unambiguously between firms that will default and those that will not. At best we can make probabilistic assessments of the likelihood of default for individual firms. Recently, major advances in the analysis of credit risk have led to the proliferation of a new breed of sophisticated credit models, which build on extensive mathematical modeling of default and loss probabilities as well as correlations between different obligors. Several of these approaches have received a great deal of attention. The four most prominent models are:²⁶

- CreditMetrics (JP Morgan)
- CreditMonitor (KMV)
- CreditRisk+ (Credit Suisse Financial Products)
- CreditPortfolioView (McKinsey)

To the practitioner, the seemingly disparate collection of new approaches may be confusing. This should be interpreted as a warning sign of the early developmental stage of the technology.²⁷ Credit risk imposes new dimensions of complexity as

²³ The well-known Fisher-Tippett theorem gives an explicit form of the asymptotic distribution of the tails for a wide class of different distributions. A good reference for the mathematical properties and theorems of extreme value theory can be found in P. Embrecht et al., "Modelling Extremal Events," Springer (1999). See also: A. McNeil, "Extreme Value for Risk Managers," Internal Modelling and CAD II published by RISK Books, 93-113 (1999)

²⁴ For an overview and further references for tail index estimation and applications of EVT to financial risk analysis, see: J. Danielsson, C. de Vries, "Value at Risk and Extreme Returns," Tinbergen Institute discussion paper, TI, 98-017/2, 1998. Downloadable form <http://www.fee.uva.nl/BIEB/TIDPs/TIDP98nr.htm>. The paper proposes an interesting semi-parametric approach, where smaller risks are captured by the non-parametric empirical distribution function (historical method), and larger risks are modeled parametrically by an estimation of the tails exponents of the distribution.

²⁵ S. N. Neftci, "Value at Risk Calculations, Extreme Events, and Tail Estimation," The Journal of Derivatives, Spring 2000, p. 23, and J. Danielsson, C. de Vries, "Value at Risk and Extreme Returns," Tinbergen Institute discussion paper, TI, 98-017/2, 1998 (21).

²⁶ An overview over the different approaches is presented in Saunder, A. "Credit Risk Measurement," Wiley Frontier in Finance (1999). The author introduces the different models mentioned above, but also gives a rather extensive literature list covering the most recent academic and non-academic research results.

²⁷A. Hickman and U. Koyluoglu demonstrated in an excellent research paper that all these different models can be considered as quite similar once simplified to one systematic risk factor and effectively produce the same result. This led the Basel commission to embrace credit risk modeling and base their new framework for a revision of the 1988 Basel Accord on Internal Rating-Based (IRB) weights. See Koyluoglu, U and Hickmann, A. "Reconcilable differences", RISK, October 1998.

return distributions are largely non-normally distributed and general diversification is reached only after including hundreds or thousands of positions in the portfolio²⁸.

Two general frameworks for valuing risky debt have evolved, each with different approaches towards the economics of default. The first pioneered by Merton describes the firm's liabilities as contingent claims issued against the firm's underlying assets.²⁹ Defaults happen for an explicit reason: The value of the firm's assets falls below the face value of the debt at maturity of the loan (in which case the debt holder receives the value of the remaining assets). There are numerous extensions of the basic model introducing more realistic capital structures.³⁰ Two of the most popular credit risk models, KMV CreditMonitor and JP Morgan's CreditMetrics, fall within this extended class of Merton based structural models.

A second class of models abstracts completely from the economics of default. These models, summarized under the term "reduced form" models, try to estimate the risk-neutral probability of default over the specified horizon from prevailing credit spreads quoted in the market. No reference to the cause of default is made. This approach relies on the availability of high quality data for credit spreads, a prerequisite that is rarely fulfilled satisfactorily. The applicability of these models is therefore extremely limited in the case of small and micro-cap firms with no publicly traded debt (which are the firms most likely to issue private convertible debentures).

VI. Conclusion

This paper presents the case for sophisticated risk management in Alternative Investment Strategies. The increasing demand for AIS products from institutional investors and a generally higher level of investor's sophistication renders the "black box" approach (i.e. investing in non-transparent and illiquid funds) more and more unsuitable. A focus on risk management will enable the industry to continue growing as rapidly as in recent years, as institutional investors are eager to invest in AIS once they are convinced the particular risks are systematically addressed. A three-pillar structure for an integrated risk management system in multi-strategy funds has been introduced. An important prerequisite for implementing this structure is transparency of the individual trading manager's positions (most efficiently achieved by a managed account). Although there is still a surprising degree of resistance to transparency in the AIS industry, the trend in investors' attitude from accepting ("trust me") to requesting ("show me") is very clearly observable.

²⁸ While a variety of theoretical modeling approaches have been developed, the empirical testing of these models is still in its infancy. An interesting survey on these can be found in Bohn, J. "A survey of Contingent Claim Approaches to risky debt valuation," Haas School of Business (1999). See also by the same author: "Empirical Assessment of a Simple Contingent-Claims Model for the Valuation of Risky Debt," Haas School of Business (1999).

²⁹ Merton, R., "On the price of corporate debt: the risk structure of interest rates," *Journal of Finance*, 29, p. 440-470

³⁰ For further information and references, see: 1. M. Crouhy, D. Galai, R. Mark, "A comparative analysis of current credit risk models," *Journal of Banking and Finance*, 24 (2000), p.59-117; 2. M. Gordy, "A comparative anatomy of credit risk models," *Journal of Banking and Finance*, 24 (2000), p.119-149; 3. Basle Committee on Banking Supervision, "Credit Risk Modeling: Current Practices and Applications" Basle (1999), available on the BIS homepage: <http://www.bis.org>

It is sometimes argued that the trading managers with the best performance will be least willing to accept increased transparency. We believe, that if there is any dependency between a trading manager refusing to be transparent and the quality of his trading performance, it is the opposite one: The more openly a trading manager discloses his strategy, the better his trading program is! Often, non-transparent strategies correspond to the inability to illustrate their edge. A manager who cannot explain his edge does not have one.

A last note concerns the issue of regulation. There is increasing effort to establish a "hedge fund" regulation scheme to be enforced by international monetary agencies. We believe that the increase in transparency and willingness to disclose AIS to investors will diminish the urge for regulation. A flexible risk management and control structure established by the industry itself is surely more preferable than a rigid set of regulations.

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Figures

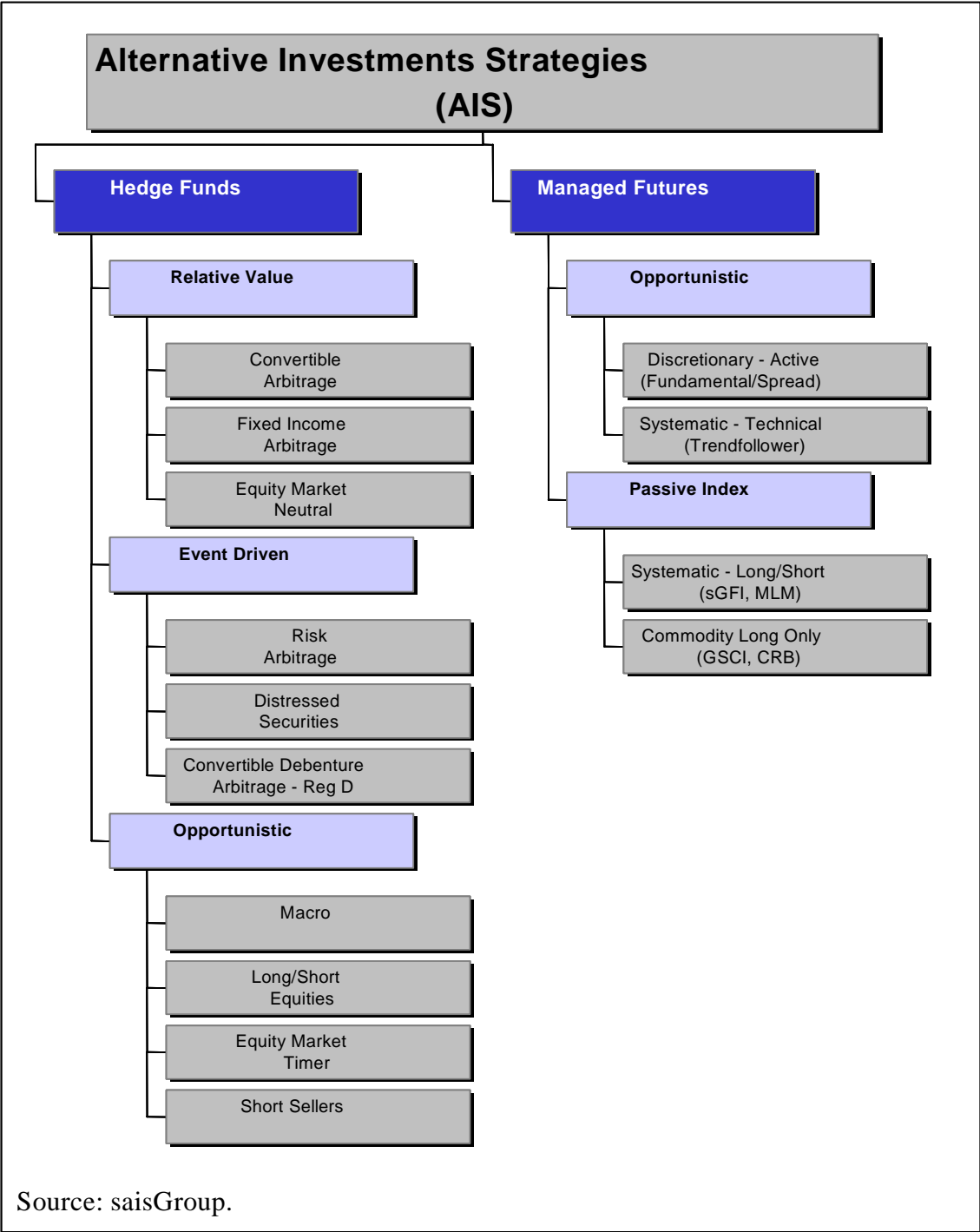


Fig.1: The universe of Alternative Investment Strategies

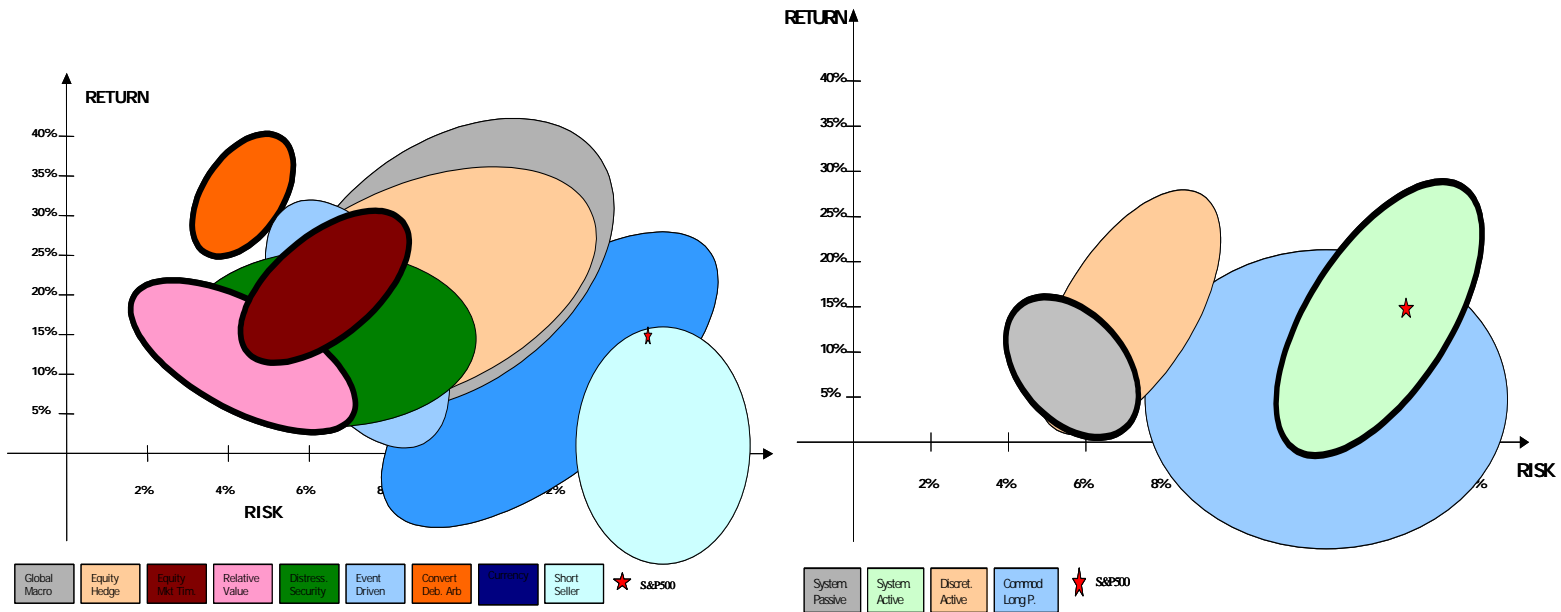


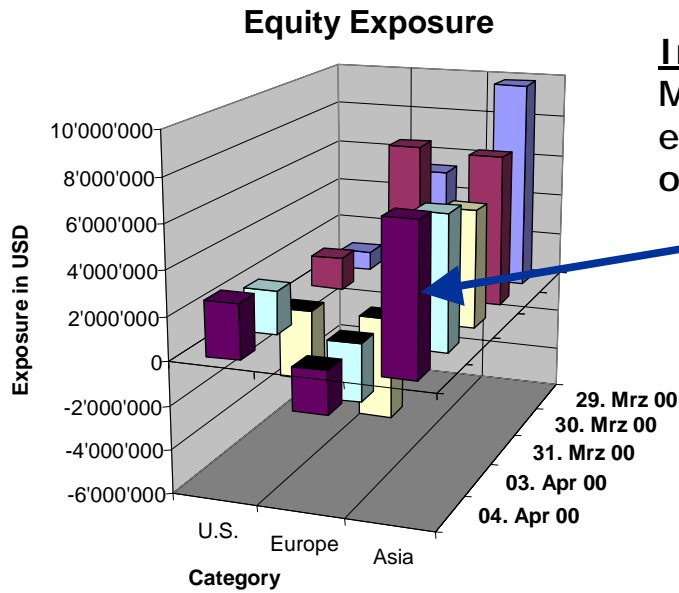
Fig.2 Risk-return profile of individual hedge fund and futures strategies

I. Strategy allocation:
Sector portfolio set is key performance driver
(Goal: High degree of diversification)

II. Manager evaluation:
Qualitative and quantitative due diligence,
("pre-investment risk management")

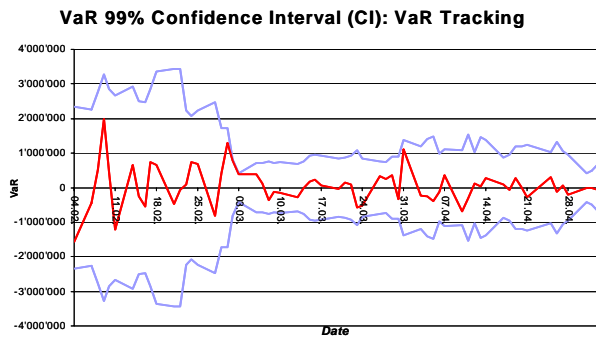
III. Continuous monitoring:
P&L and risk management
(Dynamic understanding of the strategy, risk control)

Fig. 3 The three key dimensions of AIS investing



Interpretation (Example):
Market Exposure in Asian equities was USD 6 million on April 4, 2000

Fig. 4: Exposure analysis for a portfolio's equity part



Interpretation:
There is a 1% chance (99% CI) that a daily return will be out of the blue VaR band. The red line shows the daily profit and loss (P/L).

Interpretation:
On May 3rd 2000, there was a 1% chance (99% CI) to lose about USD 100'000 in commodities for this particular fund.

VaR 99% CI Drilldown to Asset Classes

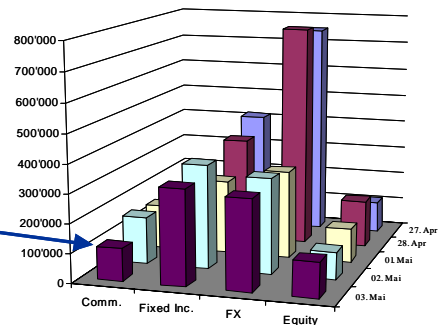


Fig. 5: VaR tracking and "Drill-Down" of VaR