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LITERATURE ON HEDGE FUNDS

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Abstract

Study of hedge funds, in the industry and in the academic world, started receiving attention after the Asian and LTCM crisis. The empirical work on hedge fund can be broadly grouped into three main categories - performance attribution (modeling returns), performance evaluation and characteristics and the impact of hedge funds on the financial markets.

Hedge funds follow a very dynamic strategy and their returns are volatile. Hedge funds have low correlation with traditional asset classes and consistently outperform mutual funds. Hedge funds appear to have risk-adjusted performance persistence. Hedge funds did not have any direct role in precipitating risk in the financial market.

LITERATURE ON HEDGE FUNDS

I Introduction

Study of hedge funds in academics and in industry is a recent phenomenon. As such, most of the literature is less than a decade old. Study of hedge funds, in industry and in academic world, started receiving attention after the Asian and LTCM crisis. Work has been done as to the benefits of adding hedge funds to the traditional investment portfolio, the performance characteristics of hedge funds and the market impact of hedge funds.

A brief description of portfolio theory is provided in Appendix A. This includes Capital Asset Pricing Model (CAPM), Asset Pricing Model (APT), and Sharpe's Style Regression which are used to make investment decisions.

This paper reviews the hedge fund literature. The empirical work on hedge fund can be broadly grouped into the following categories:

1. Performance Attribution (Modeling Returns).
2. Performance Evaluation.
3. Characteristics and the impact on the Financial Markets.

II Performance Attribution (Modeling Returns)

Attribution analysis attempts to find out the factors affecting hedge fund return. A limited number of academic researches have focussed on dissecting the sources of hedge fund return. Research has been done on the broader category of

hedge fund performance and also on particular hedge fund strategy. Research in this area can be divided into three groups:

1. Modeling hedge fund performance as a group,
2. Extracting strategies from observed returns and
3. Modeling particular hedge fund strategy.

II.A Modeling hedge fund performance as a group

In this category, the researchers model hedge fund performance treating all the hedge funds in a database as a group. No distinction is made between the different categories of hedge funds and hence what is obtained is how hedge funds perform as a group compared to other asset classes.

1. Schneeweis and Spurgin (1998)

Schneeweis and Spurgin use a multi-factor analysis to explain the performance of CTAs and hedge funds along with the mutual funds. Research has shown that, for stock and bond mutual fund investors, multi-factor models often provide improved explanatory power regarding the return structure of these investment vehicles. Hedge funds and commodity trading advisors have different trading styles (e.g., long and short positions and leverage) and trading opportunities (e.g., commodity and currency markets) than traditional stock and bond mutual fund managers. The authors thus propose that the factors that incorporate the possibility of trending prices (up or down), short sales, and volatility should better capture the return characteristics of these alternative investments.

Previous studies have focused on explanatory factor unique to a particular asset class or category. The authors use a common set of factors to describe the return movement across each of the asset classes studied. The return from active management of stock, bond, CTA, and hedge fund investments are assumed to flow from four sources:

1. **Direct return from owning financial and real assets:** The authors model this by including the nominal value of stock, bond, commodity, and currency (USDX) index returns.
2. **Flexibility to use both long and short positions:** The authors use the absolute value of the monthly returns of the underlying asset markets to model this effect.
3. **Return from Intramonth volatility:** Managers can profit from intramonth volatility either by using option strategies or through intramonth timing strategies. Returns to this factor are modeled by the intramonth standard deviation of the indexes and by computing the maximum draw-up and draw-down of the index for each month.
4. **Return from exploiting market inefficiencies that result in temporary trends in prices (Timing skill):** The authors use the Mount Lucas Management Index (MLM) as a proxy for timing skill. MLM captures the return to a moving average strategy using 20 active commodity and financial futures.

The authors use this common set of factors to explain the returns to active management of hedge funds, stock and bond mutual funds, and CTAs. Multiple regression analysis is conducted using CTA, hedge fund, and stock and bond fund indexes as the dependent variables and the nominal, absolute value, and intramonth

standard deviation of indexes as explanatory variables. Returns for all data series are expressed as monthly holding period returns. The test period, covers six years from January 1990 through December 1995.

Results indicate that these factors may help explain the differences in investment return, as well as some of the differences within each investment grouping. The authors also find that hedge funds and CTAs provide beneficial diversification to traditional stock and bond funds.

2. Ackermann and Ravencraft (June 1999)

Ackermann and Ravencraft attempt to isolate the hedge fund characteristics that might explain the performance and volatility of hedge funds. They regress risk-adjusted performance and volatility on four characteristics (management fee, incentive fee, age, U.S. vs. offshore, and six dummy variables for hedge fund categories) of hedge funds. They use the dependent variable as the natural log of standard deviation of hedge fund total monthly returns, since natural log yields a more normally distributed dependent variable and improved explanatory power. The results are summarized below:

- Incentive fee consistently explains risk-adjusted performance. Incentive fees have a negligible impact on the volatility of returns. It is possible that higher incentive fees attract superior managerial talent. It is also possible that the causation is from performance to incentive fee. Superior performance may allow a manager to negotiate a higher incentive fee.

- There is weak evidence that U.S. funds outperform offshore funds.
- Management fees raise total risk and reduce Sharpe ratios.
- Age of hedge fund has no effect on risk-adjusted return.
- No particular hedge fund category dominates in return.
- Hedge fund categories have very different total risk profiles. Event-driven, fund-of-funds, and market neutral categories have significantly lower return variances.

II.B Extracting strategies from observed returns

Different managers and databases classify hedge funds differently. One particular hedge fund could be grouped under one category (e.g. based on strategy) in one database, whereas the same hedge fund would be listed under a different category (e.g. based on investment sector) in some other database. The researchers extract strategies from observed returns and try to reclassify hedge funds based on observed return characteristics.

3. Fung and Hsieh (1997)

Fung and Hsieh extend Sharpe's model (*Style Regressions*) for analyzing investment management styles of traditional managers (relative return targets) to alternative managers with absolute return strategies. The objective is to have an integrated framework for analyzing traditional as well as alternative managers. Sharpe (1992) proposed an asset class factor model for performance attribution and

style analysis of mutual fund managers. Sharpe's asset-class model is described in Appendix A.

Sharpe (1992) demonstrated empirically that only a limited number of major asset classes is required to successfully replicate the performance of an extensive universe of U.S. mutual funds. The success of Sharpe's (1992) approach is due to the fact that most mutual fund managers have investment mandates similar to traditional asset managers with relative return targets. They are typically constrained to hold assets in a well-defined number of asset classes and are frequently limited to little or no leverage. These buy and hold investments have the mandate to meet or exceed the returns on their asset classes. Therefore, they are likely to generate returns that tend to be highly correlated to the returns of standard asset classes. Consequently, stylistic differences between managers are primarily due to the assets in their portfolios, which are readily captured in Sharpe's (1992) "style regressions."

The alternative managers, specifically, hedge fund managers and CTAs, have the flexibility to choose among many asset classes and to employ dynamic trading strategies that frequently involve short sales, leverage, and derivatives. Thus, the return of these funds is less correlated to those of standard asset classes. Consequently, the original Sharpe (1992) model must be modified to capture the stylistic differences of these alternative managers.

Hedge fund returns can be characterized more generally by three key determinants: the returns from assets in the managers' portfolios, their trading

strategies, and their use of leverage. In Sharpe's (1992) model, the focus was on the first key determinant, the 'location' component of return, which tells the asset categories used by the manager. The authors apply Sharpe's style regression to hedge funds and mutual funds. Then they factor common hedge fund styles using principal component analysis and develop an integrated framework by incorporating the extracted style factors in the regression model.

a. Style Regression

Sharpe's "style regression" can be expressed as:

$$R_{jt} = \alpha + \sum_{k} w_{kt} F_{kt} + e_t \qquad (1)$$

where $w_{kt} = \sum_{k} x_{jt} \lambda_{jk}$ and $e_t = \sum_{j} x_{jt} \varepsilon_{jt}$

The term $\sum_{k} w_{kt} F_{kt}$ is the return attributable to *style* and the residual component and $(\alpha + e_t)$ is the return attributable to *skill.* The *skill* factor can be further decomposed into (1) return attributable to *selectivity* (ability to pick stocks), and return attributable to *market timing* (ability to predict market direction).

The authors use eight-class asset-factor model to carry out Sharpe's "Style Regression" on mutual funds and hedge funds. The eight classes consist of three equity classes, two bond classes, cash, commodity and currency. The style regression results are given in Table 1.

Table 1. Style regression results of mutual funds and hedge funds.

Mutual Funds	Hedge Funds
47% have R-square >75% 92% have R-square >50%	48% have R-square <25%
99% have positive asset class coefficients 52% have coefficients statistically greater than zero and not statistically different from one	25% have negative asset class coefficients 17% have coefficients statistically greater than zero and not statistically different from one

From the results of the style regression, it is clear that hedge funds are dramatically different from mutual funds. Sharpe's style regression is suited to buy-and-hold returns on asset classes, but is not appropriate for performance attribution when applied to hedge fund managers who use dynamic trading strategies. Dynamic strategies do not have their weights, *w,* constrained between 0 and 1 due to direction (long/short) and quantity (leverage) employed. Furthermore, the ability of hedge fund managers to follow dynamic trading strategies makes it difficult to decompose the return attributable to *skill*, the $(\alpha + e_t)$ factor. For example, choice to bet on the currency market instead of stocks could be interpreted as *selection* decision or as *market timing* decision.

b. Principal Component analysis

The authors use factor analysis to determine the dominant styles in hedge funds. They identify five mutually orthogonal principal components, and later assign a quantitative style to each of these component by finding out the highest

correlation of qualitative (based on trading strategies described in the disclosure documents of hedge funds) with these principal components. The five style factors are as follows:

1. **Systems Traders**: Managers who use technical trading rules.
2. **Systems/Opportunistic**: Technically driven traders who also take occasional bets on market events relying on rule-based models.
3. **Global/Macro**: Primarily trade in most liquid markets in the world, typically betting on macroeconomic events.
4. **Value**: Traders who buy securities of companies they perceive to be undervalued based on microanalysis of fundamentals.
5. **Distressed**: Managers who invest in companies near, in, or recently emerged from bankruptcy/corporate restructuring.

The authors regress the extracted style factors on nine asset-class model to determine which of the extracted factors represent strategy choice. The regression results of extracted hedge fund style factors are shown in Table 2.

Table 2. Regression results of extracted hedge fund style factors.

Style Factors	R-square	Significant Coefficients & t-statistic (in brackets)				
		High Yield Bonds	US Equity	US Bond	Currency ($)	Emerging Market
Systems Traders	17%		Not correlated to any of the asset classes			
Systems/ Opportunistic	29%		Not correlated to any of the asset classes			
Global/Macro	55%			0.84 (3.47)	0.46 (2.43)	0.15 (2.9)
Value	70%		0.95 (7.73)			
Distressed	56%	0.89 (6.06)				

The authors conclude, from the regression results, that two of the five styles - Value (return sensitive to overall equity market) and Distressed (return sensitive to performance of high yield corporate bond market) are location choices (refers to the asset class), whereas the other three styles are dynamic trading strategies.

c. Integrated Framework

The authors extend Sharpe's approach by incorporating factors that reflect:

- Strategy component of return (that is long or short) and
- Quantity component (use of leverage) of return

They suggest a twelve-variable model to develop an integrated framework to analyze for style analysis of both buy-and-hold and dynamic trading strategies. They apply their model to 3,327 U.S. mutual funds from Morningstar and 409 hedge funds/CTA pools. The authors find that mutual fund returns are highly correlated with standard asset classes. In contrast, hedge fund managers and CTAs generate returns that have low correlation to the returns of mutual funds and standard asset classes.

Limitations of the study

The study has the following limitations:

1. Truncation error and Limited data: Hedge fund data used in the study consists of 409 funds that have at least three years monthly return and $5 million in asset.

2. The common styles extracted through factor analysis may not be comprehensive for all hedge funds. The authors omitted funds specializing in emerging market while carrying out factor analysis. They argue that in emerging markets there is limited opportunity to employ dynamic trading strategies because of lack of liquidity and prohibitions against short sales.
3. The authors relate the five principal components (style factors) extracted through factor analysis of 409 hedge funds with the qualitative style categories as commonly used in the hedge fund industry. The fact is, there is no common definitions of these qualitative style categories. Databases vary in the way they classify hedge funds categories.
4. There are number of trading strategies that are not captured by the five dominant style factors. They are short selling and arbitrage strategies. Factor analysis could not be carried out due to limited history of these strategies when this study was carried out (period 1991-1995).

4. Brown & Goetzmann

Brown & Goetzmann study the monthly return history of hedge funds over the period January 1989 through January 2000 using TASS database. The authors use a systematic, quantitative approach to using both the return history and the self-reported style information to understand and characterize the major categories of hedge fund styles during the sample period. They find that the differences in investment style contribute about 20 per cent of the cross sectional variability in hedge fund performance.

The hedge fund universe encompasses a range of different strategies and approaches. Some managers add value through knowledge of special asset markets,

others through trading skill, and others through superior asset pricing models. It is this variety that poses a challenge in comprehending and bench marking hedge funds.

The use of a simple linear model of returns to characterize investment funds does not work for hedge funds because of the dynamic use of leverage and changes in asset exposure by hedge funds. The authors use Sharpe's style regression to breakdown observed return into return attributable to skill and return attributable to style. They use generalized least square (GLS) procedure to assign funds to style categories. After estimating styles from returns using GLS, the authors map the return-based styles back to the self-reported styles. They cross-tabulate membership in a return-based style with membership in a self-reported style, and then normalize each return-based style to understand differences in style composition. The authors then label the estimated styles according to the preponderance of managers in each group.

The authors use past returns in order to determine a natural grouping of funds that has some predictive power in explaining the future cross-sectional dispersion in fund returns. Such groupings are referred to as *styles*.

The authors examine the value-at-risk for each of the eight GLS styles. They find that global equity, US equity hedge and global macro styles take more risk than other styles. Furthermore, differences in style account for significant differences in risk taking by fund managers.

II.C Modeling particular hedge fund strategy

In this category, the researchers concentrate on modeling a particular hedge fund strategy. They do not reclassify hedge funds, nor do they treat all different categories of hedge funds as a group. They take the database classification as given and study only one strategy at a time.

5. Fung and Hsieh (2001)

Fung and Hsieh having shown in their earlier work (1997) that linear factor models are not able to explain the return of hedge funds, model hedge fund returns of trend-following strategies. They use look-back straddles to model trend-following strategies, and show that they can explain trend-following funds' returns better than standard asset indices. While standard straddles lead to similar empirical results, look-back straddles are theoretically closer to the concept of trend following. They suggest that their model should be useful in the design of performance benchmarks for trend-following funds.

Hedge fund managers typically employ dynamic trading strategies. The return of hedge funds is in some cases option-like and hence would appear to have no systematic risk. In Sharpe Style analysis, it is assumed that a linear model can explain asset returns. This does not capture the nonlinear return features of hedge funds. Performance evaluation and attribution models that rely on regressing a manager’s historical returns on one or more benchmarks is sensitive to nonlinear

relationships between manager's returns and benchmarks and can result in wrong inferences.

The authors in this article model the nonlinear relationships between style factors and the markets in which the hedge funds trade. Hedge fund manager trades in the same traditional assets just like any other investor. The difference is that hedge-fund manager trades across various strategies as opposed to mutual fund manager who follows a buy and hold strategy.

The authors study a particular strategy called the trend-followers. This strategy is very common among commodity trading advisors (CTAs). This study, as per the authors, contributes to explaining the performance of hedge funds that use trend-following as part of their portfolio strategies. Fund and Hsieh (1997) identified 'trend-following' as one of the style factors in hedge fund returns. The return profile of trend-followers indicates that the relationship between trend-followers and equity market is nonlinear. The trend-followers have positive betas in up markets and negative betas in down markets. These state dependent betas lead the authors to model the return characteristics using look-back straddles. The convex return profile of trend-followers resembles the payout profile of a straddle on the underlying asset.

A look-back option is an option with payoff determined not only by the settlement price but also, by the maximum or minimum price of the underlying asset within the life of the option. A look-back straddle is a combination of look-back call option and look-back put option. The payout of a look-back straddle would be the

difference between the maximum price and the minimum price of the underlying asset during the life of the option.

The look-back straddle delivers the performance of a perfect foresight trend follower. The cost of implementing this strategy can be established using observable, exchange-traded option prices. The authors label this the 'Primitive Trend-Following Strategy' (PTFS). To empirically verify if the PTFS mimics the performance of trend followers, the authors generate the historical returns of the PTFS applied to some active markets in the world. The authors use the following markets:

1. **Stock market indices:** S&P 500, FTSE 100, DAX 30, Nikkei 225, Australian All Ordinary.
2. **Bonds markets:** U.S. 30-year, UK Gilt, German Bund, French 10-year, Australian 10-year.
3. **Currency markets:** British pound, Deutschemark, Japanese yen, Swiss franc.
4. **Three-month Interest Rate Markets:** Futures contract on the 3-month Eurodollar (CME), Euro-Deutsche Mark (LIFFE), Euro-Yen (TIFFE), Paris Interbank Offer Rate (PIBOR), 3-month Sterling (LIFFE), and the Australian Bankers Acceptance Rate (SFE).
5. **Commodity markets:** Corn, Wheat, Soybean, Crude oil, Gold, Silver.

The authors replicate the payout of a look-back straddle by rolling a pair of standard straddles, as described in Goldman Sachs et al. (1979). For each asset market, the authors label this the 'Primitive Trend-Following Strategy' (PTFS) for

that market. Empirically, they show that these PTFSs capture three essential performance features of trend-following funds.

1. The PTFS returns replicate key features of trend-following funds' returns. They both have strong positive skewness. Both tend to have positive returns during extreme up and down moves in the world equity markets.
2. Trend-following funds' returns during extreme market moves can be explained by a combination of PTFSs on currencies (Deutsche Mark & Japanese Yen), commodities (Wheat & Silver), three-month interest rates (Eurodollar and Short Sterling) and US bonds, but not the PTFSs on stock indices. This is in agreement with qualitative results in previous studies that indicate that stock indices are the least popular market to CTAs.
3. In addition, the PTFSs are better able to explain trend-following funds' returns than standard buy-and-hold benchmark returns on major asset classes, as well as benchmarks used by the hedge fund industry. The superior explanatory power of the PTFSs over standard buy-and-hold benchmarks supports the author's belief that trend followers have nonlinear, option-like trading strategies. Specifically, trend followers tend to perform as if they are long 'volatility' and 'market event risk,' in the sense that they tend to deliver positive performance in extreme market environments.

The authors indicate that the implications of these performance features are threefold:

- Trend-following funds do have systematic risk. However, this risk cannot be observed in the context of a linear-factor model applied to standard asset benchmarks.
- Trend-followers, or a portfolio of look-back straddles on currencies, bonds, and commodities, can reduce the volatility of a typical stock and bond

portfolio during extreme market downturns. This view is corroborated by the out-of-sample events in the third quarter of 1998, when the S&P declined more than 10% and the vast majority of trend-following funds made large gains.

- PTFSs are key building blocks for the construction of a performance benchmark for trend-following funds, as well as any fund that uses trend-following strategies.

III Performance Evaluation

Performance Evaluation is essentially concerned with comparing the return earned on a hedge fund with the return earned on some other standard investment asset. Research in this area can be divided into three groups.

1. Benchmarking,
2. Performance persistence and
3. Performance in a portfolio context.

III.A Benchmarking

Webster's dictionary defines a benchmark as a "standard or point of reference in measuring or judging quality, value, etc." An investment benchmark is a passive representation of a manager's investment process. It represents the prominent financial characteristics that the investment would exhibit in absence of active investment judgement.

6. Brown et al. (1999)

Brown et al. examine the performance of the offshore hedge fund industry over the period 1989 through 1995 using a database that includes both defunct and currently operated funds. The industry is characterized by high attrition rates of funds, a problem for the calculation of true investor performance. The authors use the data to develop broad stylistic classifications, and compare these with self-reported stylistic descriptions. The authors use self-reported managers' activity to group the U.S. Offshore Funds Directory universe into ten groups of basic styles and calculate the performance of hedge funds by sector. The research results can be summarized as follows:

- Offshore funds as a group have positive risk-adjusted performance when measured by Sharpe ratios and by Jensen's alpha. The authors warn against interpreting too much from the risk-adjusted performance because of survivorship bias in the performance results.
- The individual style categories provided positive value-weighted risk-adjusted performance.
- Fund-of-funds, despite being designed to select superior managers, had below average returns compared with the broad sample.
- The self-reported styles had negative correlation with asset class returns commonly used as performance benchmarks.

7. Edwards and Liew (1999)

Edwards and Liew analyze the returns of hedge funds and managed futures funds from 1982 through 1996 using MAR database. They compare the return of hedge funds and managed futures funds to the returns on a broad range of asset classes like buy-and-hold portfolios of both large and small capitalization stocks, U.S. Treasury bills, intermediate and long-term government bonds, and long-term corporate bonds.

There are two potential biases, survivorship bias and self-selection bias, in the data used for this study. The authors note that self-selection bias could also occur if data vendors include in the performance history the return that the fund earned prior to reporting to the data vendor (This is referred as instant history bias by other researchers). The authors find no self-selection bias (instant history bias) for hedge funds. The authors make some adjustments in excluding data based on 'first-reporting' dates in order to mitigate the problem of self-selection bias (instant history bias). Survivorship bias is reduced in the sample used for analysis, as the authors include both surviving and defunct funds in their data.

The authors construct equally weighted and value-weighted portfolios of hedge funds, fund of hedge funds, private pools and CTAs and calculate their Sharpe ratios and average annual returns. An equal-weighted portfolio assumes that an identical amount is invested in each fund. In a value-weighted portfolio each fund's monthly return receives a weight that reflects the amount of money that the fund has

under management relative to the total amount of money managed in that month. The authors find that hedge funds and fund of hedge funds receive the highest four rankings among all investments. Thus, given the exceptionally high stock returns since 1989, hedge funds and managed futures have provided very attractive risk-adjusted returns compared to other financial assets.

8. Ackerman and Ravenscraft (1999)

Ackerman and Ravenscraft study the performance of hedge funds by compiling two databases- HFR and MAR to obtain 906 funds. The study period is from 1988 to 1995. Returns are defined as the change in net asset value during the month divided by net asset value at the beginning of the month. Returns are net of management fees, incentive fees, and other fund expenses. The authors compare hedge fund performance to a number of general market indices and to similarly classified mutual funds. The study results are as follows authors:

- On average, hedge funds earned a mean annualized return of between 9.2 and 16.1 percent over the eight-year observation period.
- In the more recent periods, event driven and U.S. opportunistic funds earn superior returns.
- In the longer period (six to eight years) samples, global and global macro funds excel. These funds also have highest variation in returns.
- Market neutral, short sales, and fund of funds tend to earn returns below the sample average. These funds have the smallest standard deviations in individual fund returns.

- Event driven is the only category that shows above-average returns and below-average variance.
- Hedge funds do not consistently beat the market aggregates.
- Hedge funds outperform the mutual funds even on a risk-adjusted basis.
- Hedge funds are more volatile than mutual funds.

9. Schneeweis and Spurgin (1999)

Schneeweis and Spurgin discuss the different ways for estimating alpha and describe which one is the preferred method for hedge funds. Academicians define alpha as the excess return to active management, adjusted for risk. It is the return adjusted for the risk of a comparable risky asset position or portfolio. The authors discuss four basic approaches to estimate alpha:

1. $\alpha = R_i - R_f$ assumes $\beta = 0$

where: R_i is the return on fund *i*, and R_f is the return on risk-free asset.

The risk free rate is the return benchmark only if your return is not affected by any systematic information or associated market return factors other than that implied in the risk free rate.

2. $\alpha = R_i - R_m$ assumes $\beta = 1$

where: R_m is the return on the benchmark such as S&P 500.

This common variation assumes that the reference benchmark is the appropriate benchmark and that the investment strategy that is being evaluated has the same leverage as the benchmark.

3. $\alpha = R_i - \beta R_m$ assumes $R_f = 0$

A simple adjustment is made for the beta of the portfolio with respect to the benchmark. This should be used only if the asset's return is not affected by any systematic information or associated market return factors other than that implied in the comparison return benchmark. The main problem in this estimation is the use of nominal return. This may lead to positive alpha without translating into superior performance.

4. $\alpha = (R_i - R_f) - \beta(R_m - R_f)$

This is the preferred method of estimating alpha, but there are a few problems in the estimation procedure.

a) Time-varying beta: Many hedge fund strategies have a low measured beta relative to the S&P 500 over long periods of time, but over shorter periods may have a high beta. Therefore, using historical beta to measure short-term alpha leads to an upward bias.

b) The use of a single-index model assumes that the market factor in the single index model replicates the fundamental risk factor driving the return of the strategy. If this is not the case, a multi-factor model should be used to describe the various market factors that drive the return strategy.

10. Agarwal and Naik (2000)

Agarwal and Naik estimate the degree of out-performance of hedge fund strategies over a portfolio of passive strategies. The authors use a multi-factor model to estimate factor loadings and 'alphas' of different types of hedge fund strategy vis-à-vis a broad range of asset classes. They classify hedge funds into two basic

categories- directional and non-directional. Hedge fund strategies exhibiting high correlation with the market are classified as directional, while those exhibiting low correlation with the market are classified as non-directional.

On performance of hedge funds, the authors find that the non-directional strategies perform worse than S&P 500 index during market up-moves and vice versa, but perform better than directional ones on various risk-return characteristics.

The authors use an asset class factor model to evaluate the performance of hedge funds. The model can be described as:

$$R_t = \alpha + \sum_k b_k F_{kt} + u_t \qquad (2)$$

where: R_t represents return on HFR index for a particular strategy for period t

α represent abnormal return,

b_k is the factor loading,

F_{kt} represents return on the k asset-class factor or index for period t and

u_t is the error term.

They use step-wise regression technique to mitigate the multicollinearity problem since asset class factors are highly correlated. The authors find that the asset-class model explains only a small fraction of the variance of returns on the hedge funds. They attribute this to the dynamic trading strategies employed by hedge funds as opposed to predominantly buy-and-hold strategies used by traditional mutual funds. The authors interpret the intercept term as the unexplained return by the asset-factor model reflecting the skill of the hedge fund managers. They find the

intercept term in the regression to be positive and significant in all cases. The authors thus conclude that hedge fund managers exhibit superior market timing and/or security selection abilities that cannot be attributed to returns from passive portfolios.

Limitations of the study

The study has the following limitations.

1. The factors used in the asset-factor model for evaluating hedge fund returns. There is no out-of sample testing to verify the robustness of the model.
2. The use of step-wise regression to mitigate multicollinearity problem will lead to biased coefficients of the factors.
3. They re-classify hedge fund into two main categories and ten sub-categories using only 807 hedge funds from HFR database. This leads to data truncation problem.
4. The study concludes that hedge funds exhibit superior market timing and security selection ability based on significant positive alphas obtained in the regression model. This conclusion is valid only if the factor model is correct.

11. Edwards and Caglayan (2001)

Edwards and Caglayan examine the performance of hedge funds and commodity funds in bear versus bull stock markets. They compute optimal portfolio weights for the sixteen investment styles in an optimum stock and bond portfolio by maximizing the Sharpe ratio of the portfolio. They also evaluate the performance of the different hedge fund and commodity fund investment styles using the criteria of

safety (limiting downside risk) and compare these results with the Sharpe ratio performance criterion. The authors conclude the following:

1. Commodity funds have higher returns in bear markets than hedge funds, and generally have an inverse correlation with stock returns in bear markets. Thus commodity funds offer better downside protection than hedge funds.
2. Hedge funds are generally negative in bear markets, and almost all hedge fund styles exhibit significantly higher positive correlation with stock returns in bear markets than in bull markets.
3. Hedge funds ranking order remains the same whether they are ranked using individual asset Sharpe ratio or as portfolio assets.
4. The performing ranking remains the same for both bull and bear market.
5. The optimal weights given to top ranked hedge funds and commodity funds are much greater in bear markets than in bull markets.

12. Fung and Hsieh (2001)

Fung and Hsieh discuss the need for a performance benchmark for hedge funds. Hedge funds and mutual funds both trade in the same traditional asset classes, yet the return characteristics are quite different. In order to develop a performance benchmark there is a need to understand the link between hedge fund strategies and the observable asset-class returns. There are numerous hedge-fund categories, some overlapping and some exclusive. All these hedge fund categories should be reclassified into key hedge-fund styles (i.e., pairs of strategy - long/short and location - asset class). The authors suggest that these style factors may satisfy the properties

of asset-based style factor, leading to complete transparency in the way factor returns are derived.

To help investors understand hedge funds, consultants and database vendors group hedge funds into “categories” of funds based on the managers' self-disclosed strategies and location. They refer to these as "peer-group" style factors. With peer-group based style factors, only two types of information on the hedge funds in each group are available - a qualitative description of the strategies used and the historical return characteristics of the group.

For a style-factor to attain the level of information content as traditional-asset indices, two properties are essential. First, there must be complete transparency in the way the factor returns are derived. Second, there must be a sufficiently long performance history in order to generate reliable statistics. Neither property is present in peer group based and return-based hedge-fund style factors.

III.B Performance Persistence

In this category, the researchers examine whether hedge fund managers demonstrate persistence in their performance and how the survival rate affects performance persistence.

13. Park and Staum (1998)

Park and Staum examine whether managers demonstrate persistent skill. CTAs and hedge funds generate profits by having skill at producing pricing

information in an inefficient market. The authors study skill persistence for data covering 1986 to 1997 using TASS database. They add defunct funds, thus minimizing survivorship bias in the study. They use non-parametric statistical tests because of the observed violations of parametric test assumptions in the data. The authors conclude:

- There is strong evidence that skill is a factor in CTA performance and a very important factor in hedge fund performance.
- It is possible for fund of fund managers to assess traders' skill and allocate assets accordingly in order to generate higher expected returns.

14. Brown et al. (1999)

Brown et al. examine the evidence for performance persistence in the offshore hedge fund industry over the period 1989 through 1995 using a database that includes both defunct and currently operated funds. In order to study performance persistence, the authors carry out a year-by-year cross-sectional regression of past returns on current returns. The findings are:

1. There is evidence of pattern reversals in performance, that is, systematic positive, then negative dependence.
2. There is no evidence of differential manager skill. While some managers such as George Soros appear to have had a strong history of performance, they do not necessarily beat the peak each year.
3. Fund size measured by NAV (Net Asset Value) is unrelated to superior relative performance.

4. Performance persistence not found on a pre-fee basis, that is, performance fees are unrelated to future performance.

The authors conjecture that hedge fund compensation structure has implications for fund survival. Most hedge fund managers charge a fixed annual fee of 1% and an incentive fee of 20%. The incentive fee is a percentage of profit above a base, typically the asset value at the beginning of the year. Moreover, the incentive fee is generally subject to a high water mark provision. This fee structure has option-like characteristics. If the fund has the high water mark provision in the fee structure, the manager may not accept new money and may rationally adjust his strategy depending on high far he is from the high water mark. The more the manager is 'out of the money,' the more he may increase volatility. In addition, the more the manager is 'out of the money,' the less the incentive to accept new funds and the less the willingness of new investors to invest.

15. Agarwal and Naik (2000)

Agarwal and Naik examine performance persistence within individual hedge fund strategies. They compare the return of a fund manager following a particular strategy with the average return earned by all fund managers pursuing that strategy. The authors use both regression-based (parametric) and contingency table-based (non-parametric) methods for investigating performance persistence of hedge funds. The authors use quarterly returns on the individual 167 hedge funds belonging to the

ten different strategies. The results indicate a reasonable amount of performance persistence but the persistence is more for losers than for winners.

Limitations of the study

The authors did not provide any explanation for the criteria used in selecting the hedge funds for performance persistence study.

16. Agarwal and Naik (2000)

Agarwal and Naik investigate persistence in performance of hedge funds using a multi-period framework. They examine whether persistence is sensitive to length of return measurement intervals by using quarterly, half-yearly and yearly returns.

Under the null hypothesis of no manager skill (no persistence), the theoretical distribution of observing wins or losses follow a binomial distribution. The authors employ the two-sample Kolmogrov-Smirnov test to check if the observed distribution of wins and losses is statistically different from the theoretical distribution. The authors find that the extent of persistence decreases as the return measurement interval increases. Moreover, persistence seems to be driven more by losers than by winners. Performance persistence does not seem to depend on hedge fund strategy since both the directional and the non-directional funds exhibit a similar degree of persistence. The level of persistence is considerably smaller than that observed under a two-period framework with no evidence of persistence at the yearly return horizon even at the 10% level.

17. Lamm and Ghaleb-Harter (2000)

Lamm and Ghaleb-Harter examine whether there is persistence in hedge fund manager performance. They examine returns over successive one-quarter, six-month, one-year, and two-year intervals using data from Evaluation Associates Capital Management. The sample consists of monthly returns from January 1994 through December 1998 and includes a wide variety of funds engaged in numerous trading strategies. The authors regress returns for each hedge fund manager on those for seven assets: four equity groups (US large capitalization stocks, small caps, international stocks, and emerging market equities) and three types of fixed income (US government bonds, international government bonds, and global high yield).

Each hedge fund return is represented by the following equation:

$$h_j = \alpha_j + \sum \beta_{jk} \gamma_k \qquad (3)$$

where:

α_j is the portion of the jth hedge fund return attributable to manager skill,

β_{jk} measures the jth fund's exposure to the kth traditional asset, and

γ_k is the asset return.

The term $\sum \beta_{jk} \gamma_k$ represents the hedge fund style return.

The authors conclude the following:

1. There is strong persistence in manager performance across all time periods considered, with 54% to 67% of winners repeating, depending on the horizon. After adjusting for the style exposure of hedge funds, the authors

find strong evidence of performance persistence, both in the short-term and over periods as long as two years.

2. Outperforming managers deliver consistently higher alpha than do their peers. Hedge fund portfolios composed of past winners outperformed median returns by an average of 10 percent annually from 1995 through 1998.

III.C Performance in Portfolio Context

The researchers study the performance of hedge funds in a portfolio context, that is, the diversification benefits of including hedge funds in a traditional portfolio of stocks and bonds.

18. Goldman Sachs and Co. (1998)

Goldman Sachs and Co. evaluate the potential benefits of including hedge funds in plan sponsors' portfolios. They group hedge funds into four major categories: 'Market Neutral' or 'Relative Value'; 'Event Driven'; 'Long/Short' and 'Tactical Trading'. They analyze the risk/return, correlation and other performance characteristics of hedge funds over a five-year period. Their findings are the following:

1. The average returns of the Equity Long/Short and Tactical Trading strategies are about the same as the returns of the S&P 500, and well above the returns of the FT/S&P Actuaries World Indices and the Lehman Aggregate Bond Index.

2. All four hedge fund sectors demonstrate lower volatility than the two traditional equity indices. Market Neutral and Event Driven sectors show lower volatility than the Lehman Aggregate Bond Index.
3. All four sectors also demonstrate lower downside deviation than the equity index benchmarks, with the Market Neutral and Event Driven sectors below the downside deviation of the Lehman Aggregate.
4. Sharpe Ratios of all the hedge fund sectors exceed those of the three benchmark indices.
5. The risk/return profiles of all four hedge fund strategies have been more consistent than a passive exposure to the S&P 500.
6. The addition of more managers to a portfolio of hedge funds can reduce portfolio volatility without reducing expected returns.
7. Performance of hedge fund managers can be determined by:
   a) absolute return comparisons (90-day T-bills or LIBOR plus a premium, or a fixed positive return)
   b) relative comparisons (sector or peer group)
   c) risk benchmarks, using either downside deviation or standard deviation and possibly a maximum drawdown.

19. Edwards and Liew (1999)

Edwards and Liew study the diversification benefits of hedge funds and managed futures funds from over the period from 1982 through 1996 using MAR database. The inclusion of hedge funds and managed futures funds should enhance portfolio performance as the returns earned by these funds typically have a relatively

low correlation with the returns on more traditional asset classes such as stocks and bonds.

The correlation between hedge funds and stocks range between 0.37 and 0.71 in the 1989-1996 period, while the correlation between managed future returns and stocks are close to zero. Correlation between return on hedge funds and managed future funds investments are generally quite low (0.20 to 0.40), which suggests that they constitute distinct asset classes, so including both of them in a diversified portfolio could enhance portfolio performance. The authors conduct break-even analysis to determine whether hedge funds or managed futures should be included in a portfolio. The particular asset class is included in the portfolio only if the inclusion raises the portfolio's Sharpe ratio. Minimum or break-even returns can be computed for each alternative hedge fund and managed futures investment using the following inequality:

$$R_c \geq \left[\frac{\sigma_c}{\sigma_f}\right]\left(R_p - R_f\right) + R_f \tag{4}$$

where,

R_c, R_f and R_f represent the average monthly rates of return on investment *c,* on risk-less asset, and on portfolio *p* respectively,

σ_c and σ_c is the standard deviation of monthly rates of return on investment *c* and portfolio *p* respectively,

ρ_{pc} = the correlation between monthly returns on investment *c* and the monthly returns on portfolio *p*.

This break-even return R_c is the return that is required for the asset class to be included in the portfolio. If the actual return on a particular investment exceeds the

break-even return for that investment, the inclusion of that investment in a diversified portfolio will enhance portfolio performance. Over the entire 1982-1996 period, all equal-weighted and value-weighted portfolios of hedge funds and managed futures fund satisfy this criterion.

20. Lamm and Ghaleb-Harter (1999)

Lamm and Ghaleb-Harter study the appropriateness of adding hedge funds to conventional portfolios and the allocations they should receive. The author describes two hedge fund products.

a) Funds of hedge funds: Provides diversification in a convenient package by one sponsor. This saves investors significant time and expense by efficiently providing due diligence, performance evaluation, and manger monitoring. It also creates an effective instrument for investing in hedge funds as an asset class and reduces the dollar size of the investment necessary to achieve effective diversification.
b) "Enhanced-yield cash substitutes": These products typically have as an objective in outperforming Treasury returns by a target percentage.

The authors used data from Evaluation Associates, Inc. (EAI). The study finds that hedge fund returns averaged 16.5% in the 1990s with an annualized volatility of 3.5 %. The study concludes the following:

1. There is a statistically significant negative trend in hedge fund returns from 1980s onward.

2. Relative value and event-driven managers produce more conservative risk-adjusted returns.
3. All efficient hedge fund portfolios have Sharpe ratios significantly exceeding those of conventional portfolios.
4. Hedge funds enter efficient frontiers across virtually all risk levels, even when relatively low returns are assumed. Hedge funds enter efficient portfolios largely at the expense of bonds.
5. As long as hedge fund survivor bias and future expected returns subtract no more than 5 or 6 percentage points from historical returns, hedge funds are superior to any combination of conventional portfolios on a risk-adjusted basis.

21. Agarwal and Naik (2000)

Agarwal and Naik investigate the risk-return trade-off observed by including hedge funds in the portfolio, estimate the degree of out-performance of hedge fund strategies over a portfolio of passive strategies.

The authors conduct a mean-variance analysis to optimally combine alternative and passive investment strategies. On mean variance efficient frontier analysis, the authors find that a combination of alternative and passive investment strategies offer a significantly better risk-return trade-off than a passive only investment strategy. The authors find that hedge funds provide better opportunities for diversification since hedge funds have low correlation with different indices.

22. Goldman Sachs (2000)

Goldman Sachs extend their previous study to 1998-1999 data. Hedge funds pursue a variety of investment strategies, employ differing degrees of leverage, and in some cases are designed to have varying exposures to one or more asset classes and hence no single benchmark is appropriate for them. The authors study the theoretical impact of allocating 10% of the assets in pension plan to a portfolio of Absolute Return Funds (funds that exhibit downside deviation less than Lehman Aggregate Bond Index, and also low correlation with S&P 500). They also analyze the reasons for the August 1998 poor performance of hedge funds. The findings are as follows:

1. Fixed income oriented funds in general, and market-neutral fixed income funds in particular have several risks that had previously not been highlighted.
    a) Pricing anomalies that these funds attempted to capture in the past had implied investment horizons of six months or more, and had imbedded in them a presumption of normal trading liquidity. Most of these positions involved a long position in less liquid instrument and a short position in the more liquid instrument. But the exposure to normal liquidity was undiversifiable.
    b) The institutions that provided financing to hedge funds also had significant proprietary trading positions.
    c) Investors' intent to withdraw funds lead to mismatch between investment horizons of investment positions and potential demand for liquidity.
2. Equity-oriented funds, while generally faring good, also suffered from issues related to investment horizon and underestimation of certain risk factors.

3. Correlation of hedge funds between sectors and with traditional benchmarks is much lower. Hedge fund returns continue to demonstrate very attractive diversification properties, particularly in declining equity markets.
4. The overall return characteristics and diversification benefits can be achieved by hiring a relatively small subset of hedge fund managers.

23. Lamm and Ghaleb-Harter (2000)

Lamm and Ghaleb-Harter use a version of mean-variance optimization to design a portfolio of hedge funds that possess the desired alpha and beta characteristics. Adding hedge funds to the portfolio shifts the efficient frontier out by providing diversification benefits. The composition of hedge fund portfolios is critical in determining cross-asset correlation and in designing a portfolio of hedge funds, as different hedge fund styles offer varying degrees of correlation with traditional asset classes. The authors analyze 230 individual hedge funds covering the five-year period from 1994 through 1998. The data consists of monthly returns from Evaluation Associates Inc. The authors construct four optimum portfolios as follows:

a) Unconstrained portfolio except that allocation to each hedge fund must be positive.
b) Restrict net beta exposure of the hedge fund portfolio to equal zero.
c) Weight on each hedge fund is limited to maximum of 10%, but any net beta exposure is allowed.
d) Portfolio in which net beta exposure is constrained to zero and the weight of any hedge fund is limited to no more than 10%.

On analysis of these four optimum portfolios, the authors conclude the following:

- The efficient frontier shifts downward as restrictions are progressively tightened.
- Over concentration in any particular fund produces unacceptable manager risk, which is diversified away by limiting exposure to any one fund.
- For most hedge funds in most years, time-varying alpha and betas do not appear to be a major problem.

IV Characteristics and Impact on Financial Markets

In this category, the researchers study the characteristics of hedge funds and their role in the financial markets. This category can be divided into two groups:

1. Hedge Fund Industry Characteristics and
2. Role of Hedge Funds in the Financial Markets.

IV.A Hedge Fund Industry Characteristics

In this category, the researchers study the characteristics of the hedge fund industry including the fee structure, data conditioning biases and the risk/return characteristic of various hedge fund strategies.

24. Goetzmann, Ingersoll and Ross (1998)

Goetzmann, Ingersoll and Ross examine the cost and benefit of high-water mark compensation to the investor. They explore the reason for the existence of

performance based fee structure in the management of hedge funds. They develop a valuation equation based on Black Schole's option valuation model, to estimate the division of wealth that an investor implicitly makes with the portfolio manager, upon entering into such a contract.

The findings of the analysis of the compensation structure areas follows:

1. The incentive fee effectively 'costs' the investor 10% to 15% of the portfolio depending upon the variance of the portfolio.
2. The total percentage of wealth claimed by the hedge fund manager can lie between 30% & 40% taking into consideration the fixed management fee and the incentive fee.
3. The authors find that a significant portion of the compensation received by hedge fund managers is due to the incentive feature of the contract.
4. The tradeoff between the fixed fee and the high water mark fee (incentive fee) depends upon the volatility of the portfolio and investor withdrawal policy. Fixed fee portion of the contract is more when volatility is low and investment horizon is long.
5. The authors conjecture that the hedge fund industry has important limits to growth. They find that hedge funds with superior growth do not issue new shares. This could be evidence of diminishing returns to scale in management of hedge funds and the reason for existence of performance fee structure.

25. Park and Staum (1998)

Park and Staum examine the issue of skill measurement, and point out the short-comings of general risk measures:

1. Alpha cannot be a measure of skill as it is not invariant with respect to leverage.
2. Treynor-Black appraisal ratio, which is alpha divided by the residual standard error of CAPM regression is leverage-invariant. If this ratio persists, it basically measures the estimated probability of outperforming the index, not the expected amount of excess return.
3. The skill statistic (α/σ) is leverage-invariant and is interpretable as the ratio of excess reward to risk.

26. Schneeweis (1998)

Schneeweis describes the various misconceptions about hedge funds:

- For a single hedge fund, the lack of product diversification heightens its risk, but does not necessarily increase the risk of its investors.
- Hedge funds were not the cause of the Asian crisis or other major world economic collapses.
- Hedge funds offer an attractive opportunity to diversify an investor's portfolio of stocks and bonds.
- The principal economic benefit provided by hedge funds is their ability to provide capital to relatively illiquid investment markets.
- LTCM crisis has underscored the importance of diversification.
- High return investments are also potential low return investments, and trading in illiquid secondary markets is potentially disastrous in extreme conditions.
- Not all hedge funds use derivatives. Hedge funds employ a wide array of investment strategies including arbitrage strategies that use derivatives, as

well as strategies such as distressed debt, merger arbitrage, merging market debt and equity.

- The risk and return attributes of hedge funds are determined solely by their investment strategy.

27. Ackermann and Ravenscraft (1999)

Ackermann and Ravenscraft study the characteristics of hedge fund industry and investigate the impact of six forms of related data-conditioning biases.

a. Hedge Fund Industry

The authors note the following points.

- Incentive fees tend to be significantly higher in U.S., and in event-driven, global, macro and market neutral categories of hedge funds.
- Global macro and event driven funds are significantly larger in size than the average hedge fund, while short sales, U.S. opportunistic, and U.S. hedge funds tend to be significantly smaller.
- There is a positive relationship between life of fund and size, and a negative relationship between life of fund and incentive fee.

b. Data conditioning biases

The authors investigate the impact of six forms of related data-conditioning biases:

1. Survivor Bias: It is the effect of considering only the performance of funds that are alive and present in the database at the end of the sample period. This bias can be divided into two subsets.

2. Termination Bias: This bias arises because some funds drop out of the hedge fund database as they cease to exist.
3. Self-selection Bias: This bias arises as some funds voluntarily stop reporting.
4. Liquidation Bias: This bias occurs because disappearing funds may not report the final periods leading up to and including their liquidation.
5. Backfiling Bias: This occurs because when a new fund is added, the database providers typically request the full performance history for that fund, and only funds that survive the backlisting period are included.
6. Multi-period Sampling Bias: This occurs because researchers often sample only funds that exist for a certain period of time. This multi-period sampling bias excludes not only funds that failed to survive for the whole period, but also funds that enter the sample during that period.

The authors conclude the following:

- Termination and self-selection biases are most powerful.
- Liquidation bias exacerbates the termination bias, but the impact is minimal.
- Self-selection bias dominates in the U.S. hedge fund data set, and termination bias dominates offshore funds.
- Backfiling and multiyear sampling biases have a small effect.

28. Edwards (1999)

Edwards attributes the growth of hedge funds to the demographics of potential hedge fund investors and attractive performance of hedge funds. About 80% of hedge fund investors are high net worth individuals, and the remaining 20% are institutional investors such as university endowment funds and pension funds. The author compares the monthly hedge fund returns to returns on other traditional asset classes over the period 1989 through August 1998, by forming equal-weighted and value-weighted portfolios of all hedge funds in the data using MAR database.

An equal-weighted hedge fund portfolio had an average annual return of 14.23 percent, while a value-weighted portfolio had an average annual return of 18.30 percent. Over the same period, S&P 500 and Russell 2000 had annual average returns of 16.47 percent and 12.55 percent, respectively, and long-term corporate bonds had a return of 10.39 percent. The author comes up with three likely explanations for hedge fund returns:

1. Hedge funds may be exploiting price inefficiencies that exist, especially in foreign markets. This hypothesis does not mean that markets are not efficient, but that, price inefficiencies may exist because of the restrictive regulations that mutual funds and institutional money managers face. If this hypothesis is true then one can expect hedge fund returns to decline as the hedge fund industry expands and markets become more efficient.
2. Hedge fund managers possess superior skill. Perhaps the incentive fee structure of hedge funds attracts managers with the greatest skill to hedge funds. Empirically it has been difficult to prove the existence of greater skill among hedge fund managers because of non-uniformity in hedge fund

categorization and the inability to separate skill from style in hedge fund returns. Evidence on return persistence among hedge funds is not very conclusive since any observed performance persistence disappears when 'style' effects are considered.

3. Hedge funds have higher return because they take greater risk. This is inconsistent with the evidence that the authors find. Hedge funds have high risk-adjusted returns by conventional measures, like the Sharpe ratio. Using Jensen's alpha as a measure of risk-adjusted return, the authors find that 40% of hedge funds had positive Jensen's alpha, but this evidence of excess risk largely disappears when the basic CAPM model is expanded to include additional risk factors.

The author thus concludes that the question of the source of hedge fund returns or the likelihood of hedge funds continuing to earn high returns is still open for debate. High returns of hedge funds reflect the high risk that hedge fund managers take.

29. Fung and Hsieh (1999)

Fung and Hsieh summarize the differences between mutual funds and hedge funds in terms of the regulatory environment, and the investment targets. The authors provide brief descriptions of the major trading strategies of hedge funds and the return characteristics of several different styles.

The authors describe how hedge funds (and CTAs) differ from mutual funds in setting investment targets. Mutual funds have a 'relative return' target whereas hedge funds have an 'absolute return' target. In the relative return approach, the

target return can be positive or negative depending on the chosen benchmark's return. An absolute return target is fixed ahead of time and is independent of the performance of markets going forward. Hedge funds are expected to deliver performance irrespective of market conditions. Hedge fund managers use three main approaches to achieve absolute return targets:

1. Market Timing Approach: This approach bets on the directions of markets dynamically. Global, Global/Macro, Sectors, Short-Sellers, Long-Only, and trend following CTAs all employ this market timing style.
2. Non-Directional approach: This approach attempts to extract value from a set of diversified arbitrage opportunities targeted at exploiting structural anomalies of market(s).
3. Hybrid style: It is used by Event-driven funds. The managers in this area attempt to hedge away the systematic risk of the market. However, the risk in this strategy is higher than that of the Non-Directional strategies.

The authors study the return characteristics of different styles of hedge funds. Return characteristics of various hedge funds are:

- Trend following CTAs have a U-shaped return characteristic. The CTA fund tends to perform well during extreme down and up months in US equities, and less well during calmer times in US equities. The CTA fund behaves as if it owned straddles on US equities.
- The Global/Macro fund is positively correlated with stocks. It underperforms equities in up markets and outperforms equities in down markets, behaving as if it owned collars (short calls/long puts) on US equities.

- Fixed Income Arbitrage return seems to be insensitive to US equities. It tends to make 12% a year, with very little volatility.
- Short-sellers perform well in down markets and poorly in up markets.
- Distressed securities funds perform better in up markets, than in down markets. These hedge funds outperform high yield bonds in all markets.

30. Lamm and Ghaleb-Harter (1999)

Lamm and Ghaleb-Harter identify four reasons for the superior returns of hedge funds:

1. The lack of transparency in hedge fund markets.
2. The hedge fund industry cannot absorb the large amounts of funds that institutional investors need to invest in order to meet even small allocations.
3. Hedge funds are typically organized as partnerships, so, the number of investors is limited.
4. Hedge funds are not as liquid as other financial products.

31. Purcell and Paul Crowley (1999)

Purcell and Paul Crowley examine the typical hedge fund structures and strategies, and analyze the available data on historical hedge fund performance. They use MAR database and their study period is from 1991 to 1998.

a. Risk in Hedge Funds

The risks inherent in hedge fund strategies may be larger (related to capital) and are often more complex in those inherent in more traditional

accounts. There are a variety of sources that contribute to risk in hedge fund portfolios. They are:

1. **Market risk**: Although hedge funds typically reduce market risk, most do not eliminate it entirely.
2. **Security-specific risk**: It is the risk remaining after the effects of common risk factors have been removed.
3. **Non-market, common factor risk:** Between market risk and security-specific risk lies non-market risk, common factor risk, risk that arises from factors common to some, but not at all, securities. Hedge funds take on such risk by taking large positions in certain types of securities, such as stocks in specific industries, low-grade debt instruments, or "deal stocks."
4. **Liquidity risk**: Hedge funds often take very large positions relative to market liquidity.
5. **"Herd" risk**: The hedge fund community exploits the same opportunities. Thus, when the time comes to exit a trade, there is a tendency for a large proportion of fund managers to attempt to exit simultaneously. This effect magnifies the liquidity risk.
6. "**Greeks" risk**: The use of options can produce risk that changes radically as the prices of the securities underlying the options change.
7. **Borrow and counter-party credit risk**.
8. **Credit crunch risk**: To the extent that hedge funds use leverage aggressively, they can fall victim to sudden tightening of credit in the marketplace.
9. **Operational risk**: Hedge funds often run very complicated portfolios in which capital is often levered, sometimes heavily, and positions are

carefully balanced to keep risk in check. Errors in analyzing, trading, or recording positions can be very damaging.

10. **Redemption risk**: Hedge funds typically allow redemptions only infrequently, and specified times, such as quarter-ends. On redemption dates, an entire period's redemptions must be implemented simultaneously. This can force managers at inopportune times.

b. Hedge Fund Performance

The authors find the following results on the performance of hedge funds:

1. Hedge funds have exhibited strong risk/return performance during the 1990s. The hedge fund universe outperformed all benchmarks except the S&P 500, and at lower risks than all benchmarks but the Lehman U.S. Bond Index.
2. The average hedge fund experienced about the same risk as the S&P 500, but delivered lower return.
3. The set of feasible portfolios is expanded significantly when hedge funds are included. Depending on the investor's risk preference, the inclusion of hedge funds increases expected portfolio return by 200 basis points.
4. Hedge funds offer low correlations with all the other asset classes, including the S&P 500. This low degree of correlation is a major advantage for hedge funds in a portfolio context.
5. Hedge funds outperform the market during periods of poor market returns.

32. Fung and Hsieh (2000)

Fung and Hsieh discuss different types of biases present in the hedge fund performance data. They suggest using fund of funds as a proxy for the hedge fund market portfolio based on the idea that the investment experience of hedge fund investors can be used to estimate the performance of hedge funds.

It is well known that the pro forma performance of a sample of investment funds contains biases. Since the organization structure of hedge funds, is private and often offshore, it makes data collection a much more difficult task. This increases the impact of performance measurement biases.

Sharpe introduced the concept of 'market portfolio' in measuring performance of assets using CAPM model (Sharpe 1992). Market portfolio by definition includes all risky assets in the economy It is well known that though the concept of market portfolio is correct in theory, is difficult to implement in practice. Roll referred to this as the benchmark error. In performance measurement, the practice is to compare the performance of a portfolio to the return of an unmanaged portfolio of equal risk, that is, the market portfolio adjusted for risk would be the benchmark. Roll pointed out that if the benchmark (market portfolio) is mistakenly specified, it is not possible to measure the performance of a portfolio properly. Academicians and investors realize the existence of benchmark error and nevertheless use proxy market portfolio (e.g. S&P 500 index) as the benchmark. This

benchmark problem is more serious in case of hedge funds as there is no reliable documentation of the universe of hedge funds.

Hedge funds are not required to disclose their performance to the public. Therefore, the market portfolio of hedge funds is not observable. An equal-weighted portfolio of the hedge funds in a database can be used as a proxy for the market portfolio. The authors call it the ‘Observed portfolio.’ The authors document the existence of the following biases in hedge fund performance data.

1. **Selection Bias**: A 'selection' bias occurs if the hedge funds in the observable portfolio are not representative of the universe of hedge funds as some hedge funds do not participate in the database. It is a natural consequence of the way the hedge fund industry is organized. The authors find anecdotal evidence suggesting that the selection bias could be limited. It has been found that both good performers and bad performers have abstained from participating in the database.
2. **Instant History Bias**: An 'instant history' bias occurs if database vendors backfill a hedge fund's performance when they add that fund into their database.
3. **Survivorship Bias**: Some hedge funds drop out of a database because of performance reasons. This leads to ‘survivorship bias.’
4. **Sampling Bias**: This occurs because researchers often sample only funds that exist for a certain period of time.

The authors suggest the following proxies for market portfolio of hedge funds.

1. **Observed Portfolio**: This is an equal-weighted portfolio of the hedge funds in a database. This portfolio invests equal amounts in each fund in the database each month starting from the 'beginning of the data sample.' It will contain selection bias and instant history bias. Moreover, it is difficult to calculate the performance of observable portfolio because data vendors have incomplete records of defunct funds.
2. **Surviving Portfolio**: This portfolio invests in all funds that are still in the database at the 'end of the sample.' This will contain selection bias, instant history bias and survivorship bias.
3. **Fund-of-funds Portfolio**: This is an equal-weighted portfolio of fund-of-funds in the database. The survivorship bias is minimized in this portfolio as it includes performance history of both good and bad performers. The instant history bias is also minimized because when fund-of funds add a hedge fund to their portfolio the past investment records of the portfolio are not affected.

The authors used TASS database to calculate different biases. The authors suggest fund-of-funds as a better proxy for market portfolio based on the smaller impact of the biases inherent to individual hedge fund returns. Table 3 contains the results of different biases for CTAs, hedge funds and fund-of-funds.

Table 3. Types of biases in hedge funds and CTAs.

Investment Category	Survivorship bias	Instant history Bias	Selection Bias
CTAs	3.6%	3.6%	Offsetting factors.
Hedge Funds	3%	1.4%	
Fund-of-funds	1.4%	0.7%	

33. Goldman Sachs (2000)

Goldman Sachs find the following trends in the hedge fund industry.

- Hedge fund managers have multiple product offerings, often seeking to employ a common strategy or investment approach across different geographic regions or asset classes.
- There has been significant increase in funds that concentrate in particular industries or economic sectors.
- Private market investments particularly in areas such as technology.
- There has been a trend towards extending the initial lock-up period clubbed with lower management fee.
- The average equity-oriented hedge funds use less leverage than a fixed-income-oriented hedge fund even for comparable investment strategies.

34. Lamm and Ghaleb-Harter (2000)

Lamm and Ghaleb-Harter analyze 230 individual hedge funds covering the five-year period from 1994 through 1998. The data consists of monthly returns from Evaluation Associates Inc. The authors' findings are as follows:

1. Individual hedge fund behavior differs significantly by the type of strategy employed.
2. Equity hedge funds and short sellers are found to leverage more off small capitalization stock performance, indicating that managers are taking positions in more volatile small capitalization equities, where markets are typical viewed as less efficient than those for large capitalization stocks (*Renganum's Small-firm Effect*).

3. Aggressive relative-value managers, distressed event-driven hedge funds, and discretionary global asset allocators are more stylistically exposed to long positions in high yield securities with offsetting shorts in other asset classes.
4. Skill returns are fairly consistent across all asset classes with managers adding 1% monthly in incremental performance beyond that delivered by style exposure.
5. Although most hedge funds are highly correlated with each other, returns are fairly highly correlated across similar hedge fund strategies.

35. Brown et al. (2001)

Brown et al. investigate whether hedge fund and CTA return variance depends upon the manager's performance. They examine whether manager strategies are based on absolute or relative performance. The authors also analyze the factors contributing to fund disappearance.

Hedge funds and commodity trading advisors (CTAs) are compensated with contracts that pay a fixed percentage of assets and a fraction of returns above a benchmark of the treasury bill rate or zero. In addition, most of these contracts contain a 'high water mark' provision that requires the manager to make up past deficits before earning the incentive portion of the fee. This high water mark feature resets the exercise price of the call option incentive by the amount of unmet prior year targets. The asymmetric nature of incentive contract would predict that changes in risk that a manager takes are conditional upon distance from the high water mark threshold.

The authors study the 'variance strategies' of the managers (Hedge fund and CTA) who face an asymmetric compensation schedule. Goetzmann, Ingersoll and Ross (1997), Grinblatt and Titman (1989) and Carpenter (1997) all show analytically that the value of the manager's contract is increasing in portfolio variance due to the call-like feature of the incentive contract. Despite major differences in the form of manager compensation, the authors find little difference between the behavior of hedge fund/CTA managers and mutual fund managers. Given the compensation arrangements, one would expect that poor performers would increase volatility to meet their high water mark. The authors find that managers whose performance is relatively poor do increase the volatility of their funds, but managers whose return is negative do not substantially increase volatility. Theoretically, managers whose return is negative should increase volatility the most, since the performance contract is out of the money.

The authors conclude that though the high water mark feature is designed to induce behavior conditional upon absolute performance, the managers take relative performance into consideration when deciding on the 'variance strategies.' This is because survival is equally important as single-year performance. There is a trade-off between maximizing single-period fee option and survival (non-survival would tantamount to termination of option value at the end of the period).

On analyzing the factors that contribute to fund disappearance, the authors find that survival depends on volatility, age and both absolute and relative

performance of the fund. For young funds, a volatility strategy that increases the value of a performance fee option may lead to the premature death of that option through termination of the fund. Other things equal, the younger a fund, the more likely it is to fail.

IV.B Hedge Funds and the Financial Markets

In this category, the researchers study the role of hedge funds in the financial market crisis and the implications for policy.

36. Eichengreeen and Mathieson (1998)

Eichengreeen and Mathieson study the Asian carry trade using the MAR database for a period of six years, 1992 to 1997. They conclude the following:

- Hedge funds were not the first to liquidate contracts and were at the rear of the herd that was led by domestic corporations and banks.
- Estimates of hedge fund involvement are imprecise, since funds may have sold the Baht forward through offshore counterparts and through foreign and domestic banks.
- After July 2, 1997, domestic corporations fueled the depreciation by rushing for foreign exchange cover, surprising fund managers.
- Hedge funds also did not precipitate the decline of either the Malaysian Ringgit or the Philippine Peso.

37. Yago, Ramesh and Hochman (1999,1998)

Yago, Ramesh and Hochman study the characteristics of the hedge fund industry. The authors focus on three main topics:

a. Size and structure of the industry

Although all estimates suggest that industry has grown tremendously since the mid-1980s in both number of funds and in assets managed, accurate data is limited because public filings or disclosures are not mandatory. While some hedge funds disclose monthly or quarterly statements to individual investors, details on position, transactions or strategies are very limited and vague. A major limitation of hedge fund databases is that they typically have data only on funds still in existence or that are new and rapidly growing. Funds that are no longer active are dropped from the database entirely, leading to a survivorship bias. Also performance bias arises from the inclusion of new funds in databases.

b. Leveraged exposure of hedge funds and their role in Asian crisis

Hedge funds sometimes employ a considerable amount of leverage, which needs to be understood in the context of capital structure and can be very useful in creating value. The risk and return attributes of hedge funds are determined solely by their investment strategy. Some investment styles-event driven, global, market neutral and fund of funds have been less volatile

than the S&P 500, while others such as macro, sectoral and short-sales funds have been more volatile. The authors find the following:

- Most styles except for short sales seem to do well in most years against the index even after adjusting for risk.
- Hedge funds fared better and outperformed equity and bond mutual funds during the negative return months of S&P 500 index. These results are for composite hedge fund universe.
- Individual hedge funds with exposure to long equity positions often have low correlation with the S&P 500 when it is rising and high correlation when it is falling.
- The benefit of several hedge fund strategies with equity or bond exposure may arise less from their diversification advantages than their higher expected return/risk tradeoffs.
- On Asian crisis, the authors that hedge funds were not the first to liquidate their forward contracts and were at the rear of the herd, which was lead by domestic corporations and banks.

c. Performance of hedge funds

- On multi-factor analysis of hedge fund strategies, it has been found that hedge funds and CTAs have a low correlation with returns on any standard asset classes. These results are supportive of the diversification advantages of hedge funds for a typical stock and bond investor.
- Hedge funds with similar investment styles generate similar returns. There is little evidence of manager skill within a particular style group.
- Some researchers have found that volatility of returns is more persistent through time than the level of returns.

38. Edwards (1999)

Edwards explores the policy implications of the collapse of Long-Term Capital Management. The author provides the following reasons for the Fed engineering a rescue for LTCM:

- Financial markets were in a fragile state during the time of the collapse of LTCM. The Russian default lead to the bursting of moral hazard bubble as is evident from investors demanding high risk-premium for all emerging market securities including securities not connected with Russia. The plight of LTCM under such a fragile financial market would have probably destabilized the global financial markets.
- LTCM was involved in many derivative contracts and this made it necessary to avoid a formal default by LTCM. Derivative contracts, such as swaps have clauses that give the parties the right to terminate the contract if there is default by a counter party. The default of LTCM on its derivative contracts would have led to a spiraling effect on the financial markets.

The author suggests the need for more effective regulation of banks and securities firms that serve as primary market-makers in the derivatives market. The author argues that regulation of hedge funds to provide more transparency is not required. Hedge fund investors and creditors should be able to extract the necessary information from hedge fund managers because of the existence of private market for investor dollars.

> *'Competition among more than 3000 hedge funds for investors' dollars should assure that hedge fund managers will make optimal trade-off between providing more information and preserving proprietary secrets.'*

39. Brown, Goetzman and Park (2000)

Brown, Goetzman and Park test the hypothesis that hedge funds were responsible for the crash in the Asian currencies in late 1997. Their methodology is based on Sharpe's (1992) style-analysis approach that decomposes fund returns into return attributable to skill and return attributable to style.

The authors estimate the dollar exposure of the top ten global funds to Asian currencies before and during the crisis. The empirical analysis suggests little evidence that the hedge fund managers as a group caused the currency crash. On the contrary, it appears that the top ten hedge funds were buying into the Ringgit as it fell in the late summer and early fall of 1997.

The authors also examine the relation between global hedge funds and the currencies in which they speculate. They find that the currency positions of the largest funds are correlated, thus increasing dramatically the combined currency positions. They also find that the currencies remained relatively stable during the periods of high (combined) exposure of the global hedge funds. There have been periods when hedge funds had huge positive and negative exposures to Asian currencies, but these bear no relation to current, past or future moves in exchange rates. Thus, the authors conclude that the global hedge funds did not 'move' exchange rates in any significant manner.

40. Fung and Hsieh (2000)

Fung and Hsieh estimate hedge fund exposures during a number of major market events. In some episodes, hedge funds had significant exposures and were in a position to exert substantial market impact. In other episodes, hedge fund exposures were insignificant, either in absolute terms or relative to other market participants. The authors identify a sample of large hedge funds, each managing assets in excess of US$1billion at the end of 1997. They use empirical techniques to estimate hedge fund exposures using hedge fund performance data. The findings of the study are as follows:

- The episodes in which hedge fund activities were prominent and probably exerted market impact included ERM Crisis in 1992, the European bond market rally in 1993 and subsequent decline in 1994.
- The episodes in which hedge funds were unlikely to have exerted influence on the markets included the stock market crash in 1987, the Mexican Peso crisis of 1994, and the Asian currency crisis of 1997.
- There is very little evidence of hedge funds systematically causing market prices to deviate from economic fundamentals.
- There is no evidence of hedge funds using positive feedback trading strategies.
- Hedge fund did not act as a single group. There are a number of different styles. Most of the time, these styles pursued unrelated trades.
- There was no evidence that hedge funds deliberately herded other investors doing the same trade.

The implications of the empirical results are:

1. The market turmoil examined in this paper is not likely to have been caused by hedge funds.
2. It is true though that some highly leveraged trades, practiced by hedge funds as well as other market participants, can lead to market interruptions when they are unwound subsequently.
   a) The unwinding of leveraged 'carry trades' led to the 1994 Mexican Peso Crisis, in which hedge funds had no discernible role.
   b) The unwinding of leveraged 'carry trades' also resulted in the 1992 ERM Crisis and the 1997 Asian Currency Crisis, in which hedge funds had a significant role alongside other much larger, market participants.
   c) The unwinding of leveraged interest rate bets led to market disruption in 1994. In this case, hedge funds were very much involved.

   These episodes indicate that it is the strategy, not the players that can cause market disruptions.
3. Hedge fund activities may serve as a leading indicator of market turmoil. Many large hedge funds employ opportunistic trading strategies on a leveraged basis. Monitoring the strategies of hedge funds can provide early indication of potentially dangerous risks assumed by the 'market' as a whole.

V Summary

The empirical work on hedge funds leads to the following conclusion:

- Hedge funds consistently outperform mutual funds but not standard market indices.
- Hedge funds returns are more volatile.
- Inclusion of hedge funds to diversified portfolios raises the efficiency of these portfolios.
- Hedge funds have low correlation with traditional asset classes.

- Fund of hedge funds offer diversification benefits to some extent.
- Hedge funds may have risk-adjusted performance persistence.
- There may be diminishing-return-to-scale in the hedge fund industry.
- Hedge funds did not have any direct role in precipitating risk in the financial market.
- Incentive fee structure does not lead hedge fund managers to take more risk because of the possibility of non-survival.
- Hedge funds follow a very dynamic strategy.

Hedge fund literature has been discussed under four categories. A summary of the literature on performance attribution and performance evaluation is given in Table 4 and Table 5 respectively. Hedge fund characteristics are summarized in Table 6a and 6b. Table 6c summarizes the impact of hedge funds on financial markets.

Table 4. Performance Attribution (Modeling Returns).

Author	Issue	Key Finding	Time Period	Database
Modeling hedge fund performance as a group				
Schneeweis and Spurgin (1998)	Use common set of factors to explain returns for active management of hedge funds, stock and bond mutual funds, and CTAs.	Factors used explain the differences in investment return of these asset classes.	Jan 1990 to Dec 1995	
Ackermann et al. (1999)	Isolate hedge fund characteristics that explain the performance and volatility of hedge funds.	Incentive fees consistently explain risk-adjusted performance.	1988-1995, monthly data,	MAR and HFR.
Extracting strategies from observed returns				
Fung and Hsieh (1997)	Develop an integrated framework for analyzing traditional managers with relative return targets (mutual funds) as well as alternative managers with absolute return targets (hedge funds and commodity trading advisers).	Sharpe's style regression not appropriate for performance attribution of hedge funds and CTAs. Hedge funds and CTAs have low correlation with returns on mutual funds and standard asset classes.	1991-1995, monthly data.	
Brown and Goetzmann (2001)	Study monthly return history of hedge funds. The authors use return history and self-reported style information to characterize categories of hedge fund styles.	Differences in investment style contribute about 20% of the cross sectional variability in hedge fund performance. The natural groupings like the global equity, US equity hedge and global macro styles take more risk than other hedge funds.	1989 to Jan 2000, monthly data,	TASS
Modeling particular hedge fund strategy				
Fung and Hsieh (2001)	Model the nonlinear relationships between style factors and the markets in which the hedge funds trade.	The trend-following strategies can be modeled using look-back straddles.		

Table 5a. Performance Evaluation: Benchmarking

Author	Issue	Key Finding	Time Period	Database
Ackermann et al. (1999)	Performance of hedge funds.	Hedge funds consistently outperform mutual funds, but not standard market indices. Hedge funds are more volatile than both mutual funds and market indices.	1988-1995, monthly data,	MAR and HFR.
Brown et al. (1999)	Performance of offshore hedge funds.	While offshore funds are perceived to post higher returns at considerable risk, the data indicate that returns as well as standard deviation were lower than the corresponding numbers for the S&P 500.	1989-1995, annual data,	Offshore Hedge Funds Directory
Edwards and Liew (1999)	Performance of managed future & hedge funds, both as stand-alone investments and as assets in diversified stock and bond portfolios.	Hedge funds and managed futures have provided attractive risk-adjusted returns and score high as stand-alone investments. Inclusion of these assets in diversified portfolio raises the Sharpe ratio of those portfolios.	1982-1996, monthly data,	MAR.
Schneeweis and Spurgin (1999)	Different ways for estimating alpha.			
Agarwal and Naik (2000)	The degree of out-performance of hedge fund strategies over a portfolio of passive strategies.	Hedge fund managers exhibit superior market timing and security selection ability.		
Edwards and Caglayan (2001)	Performance of hedge funds and commodity funds in bear versus bull stock markets.	Almost all hedge fund styles exhibit significantly higher positive correlation with stock returns in bear markets than in bull markets.		
Fung and Hsieh (2001)	The need for a performance benchmark for hedge funds.	Hedge fund categories should be reclassified into key hedge-fund styles, that is, pairs of strategy and location.		

Table 5b. Performance Evaluation: Performance Persistence

Author	Issue	Key Finding	Time Period	Database
Park and Staum (1998)	Whether there is evidence of skill persistence in the alternative investment industry.	Evidence shows that hedge funds have risk-adjusted performance persistence.		
Brown et al. (1998, 1999)	The evidence for performance persistence of offshore hedge funds.	Performance persistence not found on a pre-fee basis, that is, performance fees are unrelated to future performance.		
Agarwal and Naik (2000)	Performance persistence within individual hedge fund strategies using both parametric and non-parametric methods.	Results indicate a reasonable amount of performance persistence but more so for losers.		HFR database
Agarwal and Naik (2000)	Performance of hedge funds using a multi-period framework.	The extent of persistence decreases as the return measurement interval increases.		HFR database
Lamm and Ghaleg-Harter (2000)	Whether the hedge fund managers who outperform tend to repeat.	Winning hedge fund managers tend to repeat during subsequent periods varying from one quarter to two years. Outperformance persistence exists when returns are adjusted for style exposure to traditional assets.	1994-1998, monthly.	Evaluation Associates Inc.

Table 5c. Performance Evaluation: Performance in a Portfolio Context

Author	Issue	Key Finding	Time Period	Database
Goldman Sachs and Co. (1998)	Potential benefits of including hedge funds in plan sponsors' portfolios.	Plan sponsors may be able to utilize certain hedge fund strategies to broaden their sources of return and improve the risk-adjusted returns.		HFR
Edwards and Liew (1999)	Performance of hedge funds as assets in diversified stock and bond portfolios.	Inclusion of hedge funds in diversified portfolio raises the Sharpe ratio of the portfolios.	1982-1996, monthly data.	MAR
Lamm and Ghaleg-Harter (1999)	Appropriateness of including fund of hedge funds and principal-protected versions of hedge funds in portfolios and the allocation that these products should receive.	Hedge funds enter efficient frontiers across virtually all risk levels, even when relatively low returns are assumed.	1993-1997, monthly data.	FRM
Agarwal and Naik (2000)	The risk-return trade-off observed by including hedge funds in the portfolio.	Hedge funds provide better opportunities for diversification.		
Goldman Sachs and Co. (2000)	The theoretical impact of allocating 10% of the assets in pension plan to a portfolio of absolute return funds.	Hedge funds have a very good diversification benefit with low correlation with common asset class benchmarks.	1994-1998, monthly data.	FRM
Lamm and Ghaleg-Harter (2000)	Design a portfolio of hedge funds that possess the desired alpha and beta characteristics.	The efficient frontier shifts downward as restrictions are progressively tightened.	1994-1998, monthly.	Evaluation Associates Inc.

Table 6a. Hedge Fund Characteristics: 1998 and 1999.

Author	Issue	Key Finding	Time Period	Database
Goetzmann et al. (1998)	The effect of high water mark compensation scheme.	High water marks lend to managers having an incentive to taking risk. Existence of high water mark is due to diminishing returns to scale in the hedge fund industry.	1990-1997 annual data.	Offshore Funds Directory
Park and Staum (1998)	The issue of skill persistence and the short-comings of general risk measures.	Skill statistic is leverage-invariant.	1991-1997	
Schneeweis and Spurgin (1998)	Misconceptions about hedge funds.	Not all hedge funds use derivatives. The principal economic benefit of hedge funds is their ability to provide capital to relatively illiquid investment markets.		
Ackermann et al.(1999)	Characteristics of hedge fund industry and the impact of data conditioning biases.	Positive relationship between the life of funds and size, and negative relationship between life of funds and incentive fee. Termination and self-selection biases are most powerful.	1988-1995, monthly data.	MAR and HFR
Edwards (1999)	Hedge fund industry study.	High returns of hedge funds reflect the high risk that hedge fund manager takes.	1982-1996, monthly data.	MAR
Fung and Hsieh (1999)	Return characteristics of different styles of hedge funds.	Global/Macro fund is positively correlated with stocks. Fixed Income Arbitrage return is insensitive to US equities.		
Lamm et al. (1999)	Reasons for superior returns of hedge funds.	Lack of transparency and illiquidity contribute to superior performance.	1991-1997, monthly.	Evaluation Associates Inc.
Purcell and Crowley (1999)	Hedge fund structures and strategies, and analyze hedge fund performance.	Hedge funds have larger and more complex risk than the traditional accounts. Hedge fund risk-return characteristics and correlation make them an attractive addition to a traditional diversified portfolio.	1991-1997, monthly.	MAR

Table 6b. Hedge Fund Characteristics: 2000 and 2001.

Author	Issue	Key Finding	Time Period	Database
Fung and Hsieh (2000)	Different types of biases present in the hedge fund performance data.	Suggest fund-of-funds as a better proxy for market portfolio based on the smaller impact of biases inherent to individual hedge fund returns.		TASS
Goldman Sachs (2000)	Trends in hedge fund industry.	The average equity-oriented hedge funds use less leverage than a fixed -income-oriented hedge fund even for comparable investment strategies.	1994-1998, monthly data.	Financial Research Management
Lamm et al. (2000)	Performance of hedge funds over a five-year period.	Individual hedge fund behavior differs significantly by the type of strategy employed. Hedge funds are highly correlated with each other.	1991-1997, monthly data.	Evaluation Associates Inc.
Brown et al. (2001)	Whether hedge fund and CTA return variance depends upon the manager's performance. The factors contributing to fund disappearance.	Trade-off between maximizing single-period fee option and survival. Survival depends on volatility, age and both absolute and relative performance of the fund.	1989-1995, annual data.	Offshore Hedge Funds Directory

Table 7. Hedge Funds and the Financial Markets.

Author	Issue	Key Finding	Time Period	Database
Yago et al. (1998, 1999)	Role of hedge funds in Asian crisis.	Hedge funds were at the rear end in liquidating their forward contracts on Asian currencies.		
Eichengreen and Mathieson (1998)	The Asian currency trade.	Evidence shows that hedge funds were not the first to liquidate contracts.	1992-1997	
Edwards (1999)	The policy implications of the collapse of LTCM.	Need for better risk management technique.	1982-1996, monthly data.	MAR
Brown et al. (2000, 2001)	Testing of the hypothesis that hedge funds were responsible for the 1997 crash in the Asian currencies.	Hedge fund managers as a group did not cause the crash.		
Fung and Hsieh (2000)	Hedge fund exposures during a number of major market events.	No evidence of hedge funds using positive feedback trading strategies.		MAR, TASS

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Appendix A. Portfolio Theory

Portfolio theory is the area of finance that discusses decisions involving outcomes that can not be predicted with complete certainty. In the early 1950s, Harry Markowitz developed the basic elements of portfolio theory. In 1958, James Tobin made the first attempt to use the theory for a positive capital market model. The computational procedure needed to perform portfolio analysis was simplified by William Sharpe's Capital Asset Pricing Model (CAPM) published in 1964. However, a complex quadratic equation still had to be solved in order to select optimum portfolios. In the early 1970s, Stephen Ross developed the model known as Asset Pricing Theory (APT). In 1980, Richard Roll provided results that support the APT because the model was able to explain different rates of return, in some cases with results that were superior to those of the CAPM.

Risk has been an integral part of decision-making in the investment industry, even during the 1950s and early 1960s. To build a portfolio model, investors had to quantify the risk variable, but there was no specific measure for the term. Harry M. Markowitz in the landmark paper published in 1952 developed the expected rate of return for a portfolio of assets and an expected risk measure. This is viewed as the origin of the 'modern portfolio theory' approach to investing. Markowitz's approach to investing begins by assuming that an investor has a given sum of money to invest at the present time. This money will be invested for a particular length of time, known as the investor's holding period. At the end of the holding period the investor will sell the securities that were purchased at beginning of the period, then either spend the proceeds on consumption or reinvest the proceeds in various securities (or do some of both). At the beginning of the period, the investor must make a decision on what particular securities to purchase and hold until the end of the period. Since a portfolio is a collection of securities, this decision is equivalent to selecting an optimal portfolio from a set of possible portfolios and is thus often referred to as 'portfolio selection problem' (Markowitz).

In making this decision at the beginning of the period, the investor recognizes that security returns (and thus portfolio returns) over the forthcoming holding period are unknown. Nevertheless, the investor can estimate the expected returns (or mean returns) on the various securities under consideration. The investor could then invest in the security that has the highest expected return of all the securities under consideration. Markowitz notes that this would generally be an unwise decision because the typical investor, while wanting returns to be high, also wants returns to be as certain as possible. This means that the investor in seeking both to maximize expected return and minimize uncertainty (that is, risk), has two conflicting objectives that must be balanced against each other when making the purchase decision at the beginning of the period. The Markowitz approach for how the investor should go about making this decision gives full consideration to both of these objectives. One interesting consequence of having these two conflicting objectives is that the investor should diversify by purchasing not just one security but several of them (Reilly).

A.1 Markowitz'z Efficient Frontier

Markowitz's approach to investing is based on statistics, in as much as it begins with the premise that security returns are random variables. As with random variables, securities (and in turn, portfolios) can be compared by examining their moments. Markowitz has suggested that the investor should look at two such moments - expected return and standard deviation. The investor should first determine the expected return (also known as mean return) and standard deviation of the return associated with each portfolio, while analyzing a set of portfolios. Markowitz showed that the variance of the rate of return was meaningful measure of portfolio risk under a reasonable set of assumptions, and he derived the formula for computing the variance of a portfolio (Markowitz).

Markowitz showed that the expected rate of return of a portfolio is the weighted average of the expected return for the individual investments in the portfolio. It can be expressed as:

$$E(R_{port}) = \sum_{i=1}^{n} \{W_i E(R_i)\} \tag{A.1}$$

where: $E(R_{port})$ is the expected return for the portfolio,

W_i is the percent of the funds invested in asset *i* and

$E(R_i)$ is the expected rate of return for asset *i*.

The standard deviation σ_i of the returns for any asset *i* can be expressed as:

$$\sigma_i = \sqrt{\sum_{i=1}^{n} \{[R_i - E(R_i)]P_i\}} \tag{A.2}$$

where: P_i is the probability of the expected rates of return, $E(R_i)$.

The standard deviation of returns for a portfolio of assets cannot be calculated directly using the Equation A.2 because the returns of individual assets in the portfolio may vary in different directions from each other, and thus tend to reduce the variability of the portfolio. The standard deviation of a portfolio is a function of the standard deviation of the individual assets in the portfolio, and also of the covariance between the rates of return for all the pairs of assets in the portfolio. The equation for covariance between two assets can be expressed as:

$$Cov_{i,j} = \frac{1}{n}\left\{\sum_{t=1}^{n}\left[(R_{it} - E(R_i))(R_{jt} - E(R_j))\right]\right\} \tag{A.3}$$

The magnitude of the covariance depends on the magnitude of the individual asset's standard deviation and the relationship between the co-movements of the two assets. The covariance is measured in return units squared. Correlation coefficient is a

measure of linear association between two assets and is not dependent on unit of measurement. The correlation coefficient can be expressed as:

$$r_{i,j} = \frac{Cov_{i,j}}{\sigma_i \sigma_j} \tag{A.4}$$

The standard deviation for two-stock portfolio can be expressed as:

$$\sigma_{2stock\_portfolio} = \sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2Cov_{1,2}} \tag{A.5}$$

For a multi-asset portfolio, Equation A.5 can be expressed as:

$$\sigma_{port} = \sqrt{\sum_{i=1}^{n}\left(W_i^2\sigma_i^2\right) + \sum_{i=1}^{n}\left[\sum_{j=1}^{n}\left(W_iW_jCov_{i,j}\right)\right]} \qquad i \neq j \tag{A.6}$$

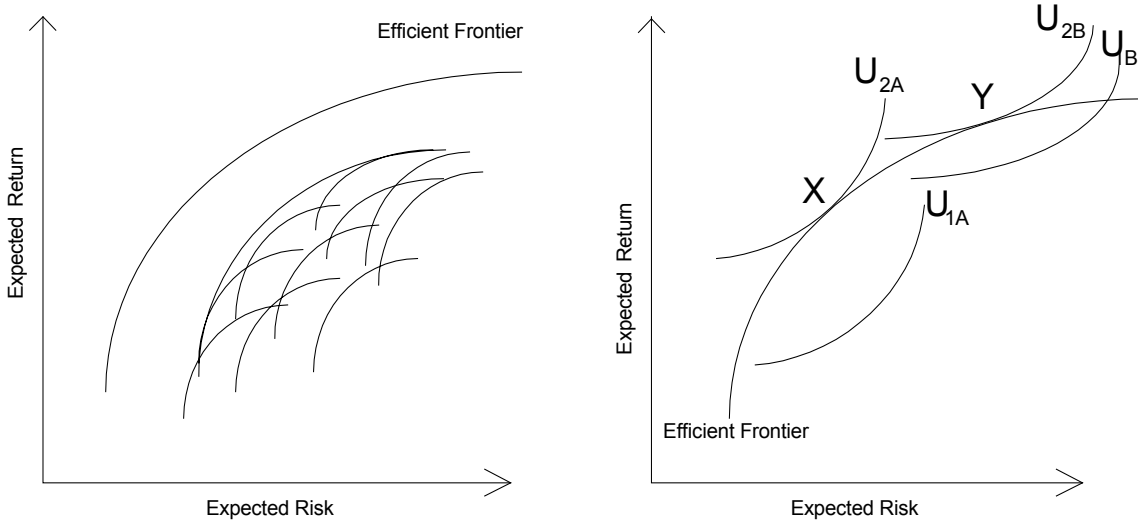
Equation A.6 can be rewritten by using Equation A.4 as:

$$\sigma_{port} = \sqrt{\sum_{i=1}^{n}\left(W_i^2\sigma_i^2\right) + \sum_{i=1}^{n}\left[\sum_{j=1}^{n}\left(W_iW_j\sigma_i\sigma_jr_{i,j}\right)\right]} \qquad i \neq j \tag{A.7}$$

The above equations for the standard deviation of the portfolio not only indicated the importance of diversifying the investments to reduce the total risk of a portfolio, but also showed how to diversify effectively. Correlation coefficients among assets are the critical factors that should be considered when selecting investments, because the investor can maintain the rate of return while reducing the risk level of the portfolio by combining assets or portfolios that have low positive or negative correlation. Different weights or amounts of a portfolio held in various assets yield a curve of potential combinations.

Markowitz observed that there are no assets that are perfectly positively or perfectly negatively correlated. Thus the risk of a portfolio will always be less than the weighted

average of the individual risks of the assets in the portfolio. Markowitz's efficient frontier is the representation of the risk return trade-off. Figure A.1 (a) shows various two-asset portfolios and the resultant envelope curve obtained by combining the various two-asset portfolios. The envelope curve that contains the best of all these possible combinations is called the **efficient frontier**. The efficient frontier bows backward towards the Y-axis because of less than perfect correlation between the assets in a portfolio. Portfolios on the efficient frontier are efficient in that there is no other combination of stocks that offer that high a return for the risk taken. Combining the efficient frontier and an investor's indifference curve map will indicate which efficient portfolio satisfies the investor's risk-return trade-off. Figure A.1 (b) shows two sets of utility curve along with the efficient frontier of investments. Investor A is more risk-averse and investor B is less risk-averse. The optimal portfolio for each investor is the point of tangency between the efficient frontier and the highest indifference curve for the investor. The conservative investor A's highest utility occurs at point X while the less risk-averse investor B's highest utility occurs at point Y.



(a) (b)

Figure A.1 Efficient Frontier and Investor Utility Function for Two Investors.

The important message of the Markowitz's portfolio theory was that assets could not be selected only on characteristics that were unique to the security. An investor had to consider how each security co-moved with all other securities. Furthermore, taking these co-movements into account resulted in an ability to construct a portfolio that had the same expected return and less risk than a portfolio constructed by ignoring the interactions between securities.

A.2 Tobin's Separation Theorem

James Tobin developed conditions under which Markowitz's mean-variance theory could be optimal. Tobin based his analysis on the liquidity preference theory (also known as liquidity premium theory). Tobin showed that, under certain conditions, Markowitz's model implies that the process of investment choice can be broken down into two phases:

1. The choice of a unique optimum combination of risky assets;
2. A choice concerning the allocation of funds between such a combination and a single riskless asset.

Tobin's Separation Theorem shows that each investor should hold only two portfolios: an efficient risky portfolio and the riskless asset. The composition of the risky portfolio is independent of the investor's preferences and depends only upon the expected returns and covariances of returns among securities (Reily).

A.3 Sharpe's Capital Asset Pricing Model

The theory of Markowitz and Tobin could not be implemented because it required the inversion of the covariance matrix of returns among all securities under consideration. This was an impossible task at a time when computing power was limited.

In order to overcome this practical obstacle, William Sharpe suggested an index model, called the Capital Asset Pricing Model (CAPM). Sharpe showed that if all

investors follow Markowitz's mean-variance approach, the expected return on a security will be positively and linearly related to the level of its beta, which measures the stock's relative volatility. In other words, the higher a security's beta the higher its expected return. The beta of a security and not the standard deviation (or variance) of the security is the relevant measure of the security's risk.

Markowitz's efficient frontier did not consider the existence of a risk-free asset. Adding the risk-free asset to the Markowitz's portfolio construction process allows portfolio theory to develop into capital market theory. When a risk-free asset, *rf*, is combined with a risky asset, *A,* the expected return of the portfolio will be:

$$E(R_{port}) = W_{rf} R_{rf} + W_A E(R_A) \tag{A.8}$$

where: W_{rf} is the percent of the funds invested in risk-free asset *rf* ,
R_{rf} is the expected rate of return for risk-free asset *rf*
W_A is the percent of the funds invested in asset *A* and
$E(R_i)$ is the expected rate of return for asset *A*.

The standard deviation of the two-asset portfolio will be:

$$\sigma_{port} = \sqrt{\left[W_{rf}^2 \sigma_{rf}^2 + W_A^2 \sigma_A^2 + 2 W_{rf} W_A \sigma_{rf} \sigma_A r_{rf,A}\right]} \tag{A.9}$$

The risk-free rate is stationary, thus its covariance and correlation coefficient with all other assets is zero. Therefore, Equation A.9 can be simplified as:

$$\sigma_{port} = \sqrt{\left[W_A^2 \sigma_A^2\right]} = W_A \sigma_A \tag{A.10}$$

The introduction of a risk-free rate changes the Markowitz's efficient frontier into a straight line. This straight efficient frontier line is called the Capital Market Line (CML) as shown in Figure A.2.

The market portfolio is the tangent point (M) where the CML touches the efficient frontier. Since, investors will only want to invest in the risk-free asset and the market portfolio, all assets must be in the market portfolio. Risk seeking investors wanting more risk than offered by the market will borrow and move their portfolios to

the right of the market portfolio. Investors seeking safety will lend some of their funds at the risk-free rate and will move to the left of the market portfolio.

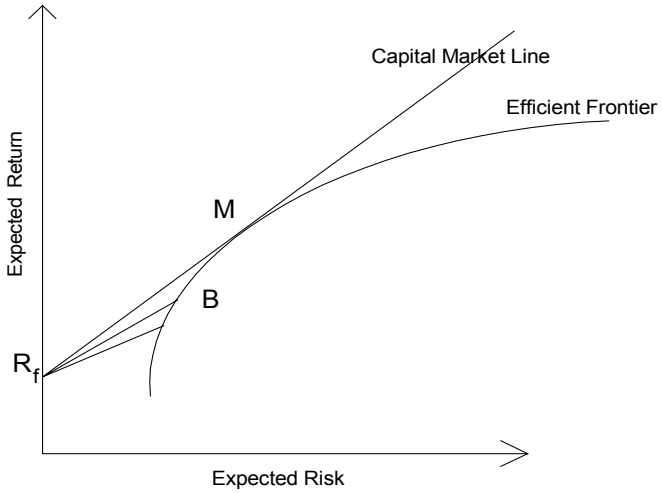


Figure A.2 Capital Market Line

When an investor diversifies, if the assets are not perfectly correlated, the portfolio's risk is less than the weighted sum of the risks of the individual securities that are in the portfolio. The risk that disappears in the portfolio construction process is called the asset's diversifiable risk or unsystematic risk. The risk that remains is called the market risk or nondiversifiable risk or the portfolio's systematic risk. Total risk is the summation of Systematic Risk and Unsystematic Risk. Figure A.3 shows the two kinds of risk in a portfolio.

When return is plotted against risk, the risk measure (the independent variable X) must be the measure of risk that influences return (the dependent variable Y). Investors are nor and should not be paid for diversifiable risk. Therefore, the proper relationship is return vs. systematic risk. Using beta as a measure of systematic risk the relationship between risk and expected rate of return on an asset can be represented by the Security Market Line (SML).

The Security Market Line (SML) can be expressed as:

$$E(R_i) = R_{rf} + (E(R_M) - R_{rf})\beta_i \quad \text{(A.11)}$$

where: $E(R_i)$ is the expected rate of return for asset *i*.

R_{rf} is the return on the risk-free asset *rf*,

$E(R_M)$ is the expected rate of return on the market portfolio, *M* and

β_i is the systematic risk of asset, *i*.

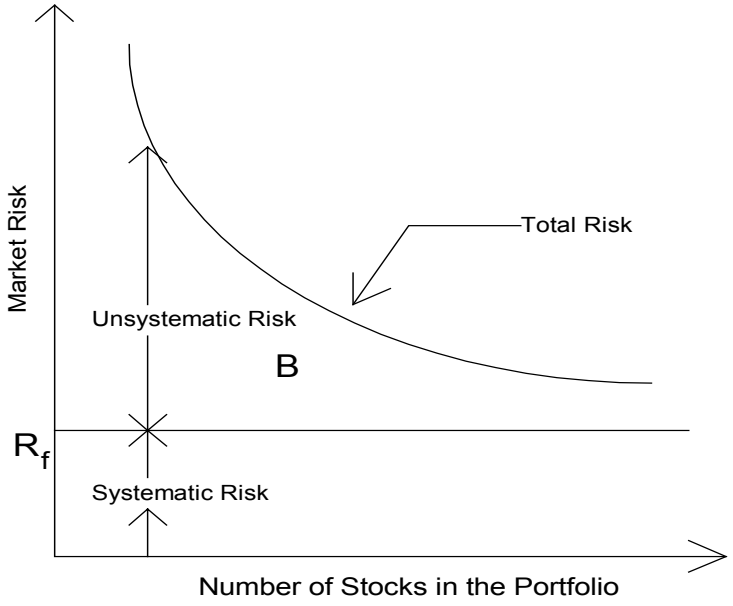


Figure A.3 Types of Risk

The Equation A.11 is called the capital asset pricing model (CAPM). The CAPM is a single risk factor (beta) model of explaining security returns. The term $(E(R_M) - R_{rf})$ is called the market risk premium.

Sharpe assumed that, for the sake of simplicity, the return on a security could be regarded as being linearly related only to some index. This would eliminate the need to consider any direct relationship between securities. It could simply be assumed that any tendency for stocks to move together was caused by their common relationship to the single underline factor being measured by the index. In this initial presentation of the model any index that could be found to work was regarded as acceptable, whether it was an economic index, a stock price index, or some personally selected index. The only requirement, of course, was that the stocks have a relationship with whatever index was chosen (Valentine).

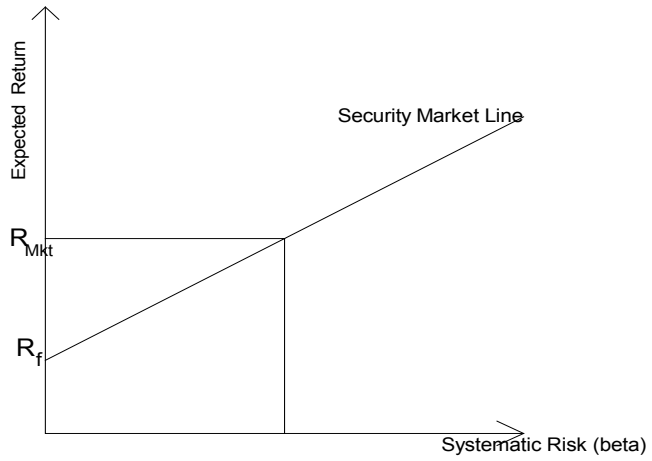


Figure A.4 Security Market Line.

The CAPM provides an interesting way to look at the set of possible portfolios, but does not show how investors could be expected to behave if they have different expectations. Each would buy a stock portfolio that he would regard as most efficient, but this ‘efficiency’ is defined in terms of his own personal expectations.

A.4 Arbitrage Pricing Theory

CAPM assumes that investors have quadratic utility functions and that the distribution of security prices is normal, that is symmetrically distributed, with a variance term that can be estimated. Arrow & Hikes have pointed out that the assumption of quadratic utility is highly implausible in that it implies increasing absolute risk aversion. Also, the assumption of normally distributed investment return carries with it the unrealistic implication of unlimited liability and rules out asymmetry or skewness in the probability distribution of returns. In addition, researchers like Linton, Rosenburg and others have found that actual security price data are well approximated by lognormal and not normal distribution (Elton and Gruber).

Roll and Ross criticized the CAPM model because of its dependence on a market portfolio of risky assets. They contend that such a portfolio is not currently available. Roll and Ross point out that when CAPM is used to evaluate portfolio performance, it is necessary to select a proxy for the market portfolio as a benchmark for performance. Research shows that the performance results can be changed substantially because of the market proxy used [Roll and Ross, p.1090]. Ross subsequently devised an alternative Asset Pricing Model (APT) with fewer assumptions that does not require a market portfolio (Ross). The following major assumptions are not required:

1. Quadratic utility function,
2. Normally distributed security returns and
3. A market portfolio that contains all risky assets and is mean variance efficient.

The APT is a multi risk factored asset pricing model that allows more than one risk factor to influence security prices. The theory behind this model is that arbitrage activities will cause security prices to remain in equilibrium. The assumptions of APT are as follows:

1. The capital markets are competitive,
2. Investors prefer more wealth to less wealth and
3. Zero investment arbitrage exists. Zero investment arbitrage means if an investor shorts an overpriced security, the investor has access to short sale money to buy an underpriced security.

The APT model begins with an assumption of the return generating process. Individuals are assumed to believe (homogeneously) that the random returns on the set of assets being considered are governed by a *k*-factor generating model. The return generating function can be expressed as:

$$r_{it} = E(r_{it}) + B_{im} f_{mt} + e_{it} \qquad \text{(A.12)}$$

where: r_{it} is the observed rate of return for the *i*th asset at time *t,*

$E(r_{it})$ is the expected rate of return for the *i*th asset at time *t,*

B_{im} is the factor sensitivity of the *i*th asset associated with the risk factor *m*,

f_{mt} is the risk factor *m*

e_{it} is the error term for the asset *i*

Equation A.12 can be written using matrix notation as:

$$\mathbf{R} - \boldsymbol{\mu} = \mathbf{BF} + \boldsymbol{\varepsilon} \qquad \text{(A.13)}$$

where: $\mathbf{R}$ and $\boldsymbol{\mu}$ are (*i* x *t)* matrices of observed and expected return respectively,

$\mathbf{B}$ is *(i* x *m)*matrix of factor loadings,

$\mathbf{F}$ is *(m* x *t)*matrix of risk factors, and
$\boldsymbol{\varepsilon}$ is *(i* x *t)* matrix of error terms

The *m* deviations (X-…) are expressed in terms of *(k + m)* random variables F_1, F_2, …., F_k, ε_1, ε_2, …., ε_m which are unobservable. This distinguishes the APT factor model from the multi-variate regression model, in which the independent variables can be observed. The common risk factors capture the systematic components of risk in the model and the unsystematic risk component is captured by the error term. The APT model does not specify or identify the risk factors.

A.5 Sharpe's Style Regression

Style regression is a special case of the APT factor model described above. In such a model each factor represents the return on an asset class and the sensitivities, B_{im} values, are required to sum to 1(100%). In effect, the return on an asset *i* is represented as the return on a portfolio invested in *m* asset class plus a residual component, e_i. A key contribution of this approach is a separation of return into two main components: return attributable to *style* and return attributable to *selection.*

For realized return, Equation A.12 can be written as:

$$R_i = \alpha + \sum_k b_k F_{ki} + e_i \tag{A.14}$$

The term $\sum_k b_k F_{ki}$ is the return attributable to *style* and the residual component $\alpha + e_i$ is the return attributable to *skill.* The *skill* factor can be further decomposed into return attributable to *selectivity* (ability to pick stocks), and return attributable to *market timing* (ability to predict market direction). Selectivity consists of diversifiable risks of individual stocks whereas market timing consists of nondiversifiable, nonlinear payouts of asset class returns based on trading strategies.

The traditional view of asset allocation assumes that an investor allocates assets among (potentially many) funds, each of which includes (potentially many) securities. Ultimately one is interested in the investor's exposures to the key asset classes. These are a function of the amounts of investor's portfolio invested in various funds, and the exposures of each fund to the various asset-classes. The exposures of a fund to the various asset classes are, in turn, a function of the amounts that the fund has invested in various securities, and the exposures of the securities to the asset classes. Investor's return determined by the percentage of capital invested in different funds, for example,

Fidelity Magellan, Fidelity Balanced Fund, etc. A particular fund's return is determined by the percentage of capital invested in various securities, for example, Fidelity Balanced Fund may invest in growth stocks, value stocks, corporate bonds, etc.

While it is possible to attempt to determine a fund's exposures from a detailed analysis of the securities held by fund, a simpler approach typically provides more than enough information for purposes of asset allocation. Such a method uses only realized fund returns to establish the typical exposures of the funds to the asset classes. The procedure is to use multiple regression analysis with fund returns as the dependent variable and the asset-class return as the independent variable. The resulting slope coefficients could then be interpreted as the fund's historic exposures to the asset class returns.

It is important to note that the style identified in such an analysis is, in a sense, an average of potentially changing styles over the period covered. Month-to-month deviation's of the fund's return from that of style itself can arise from selection of specific securities within one or more asset classes, rotation among asset classes, or both security selection and asset class rotation.