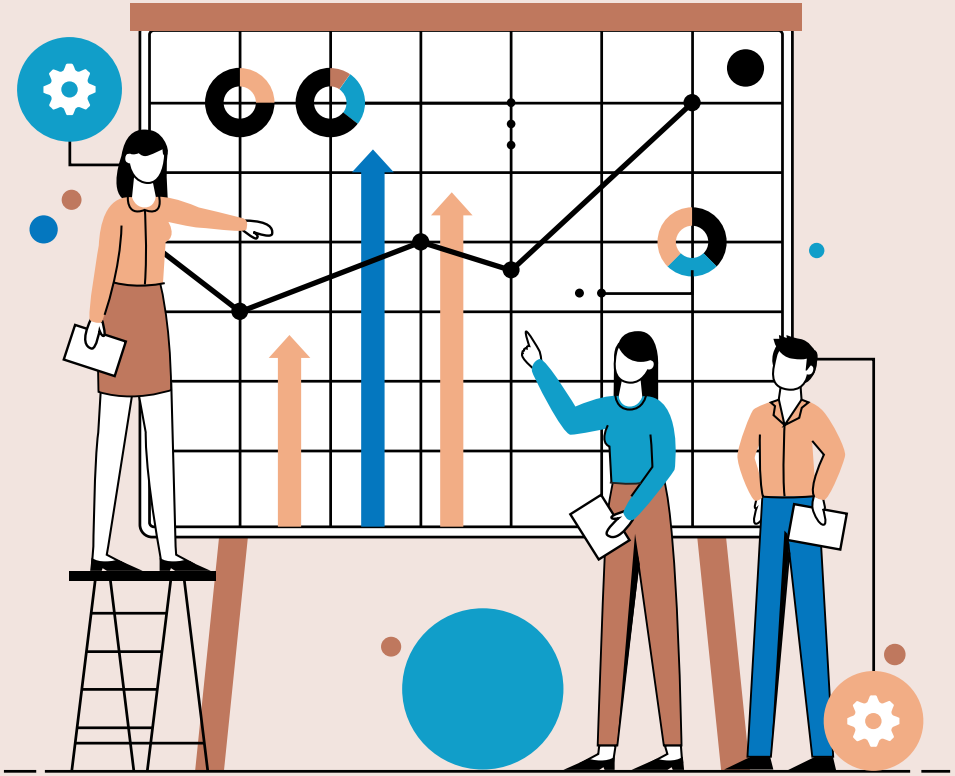
GS- Quant Case Study



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Problem Statement :

To propose a quantitative framework to select funds from a universe, and monitor them on an ongoing basis, with criteria for removal from the AIMS platform

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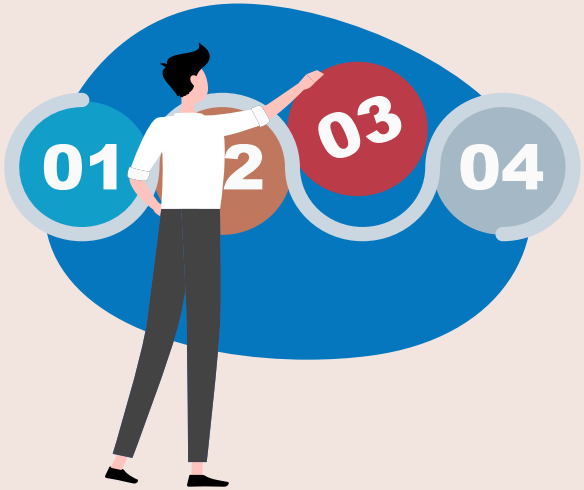
INTRODUCTION

To build a portfolio that will help you achieve your financial goals, you must accomplish two things perfectly. To begin, you must decide on an asset allocation that is appropriate for you. Second, you must put that asset allocation into action correctly.

A quantitative framework is a collection of rules and/or criteria for choosing and monitoring mutual funds. A quantitative framework is beneficial since it can assist you in being disciplined in your decision-making process and ensuring that you are only investing in the top mutual funds. It's crucial to identify which aspects to include in your quantitative framework before you start. This can help you make better decisions and ensure that you're only investing in the top mutual funds. Your investment goals, risk tolerance, and time horizon should all be aspects to consider.

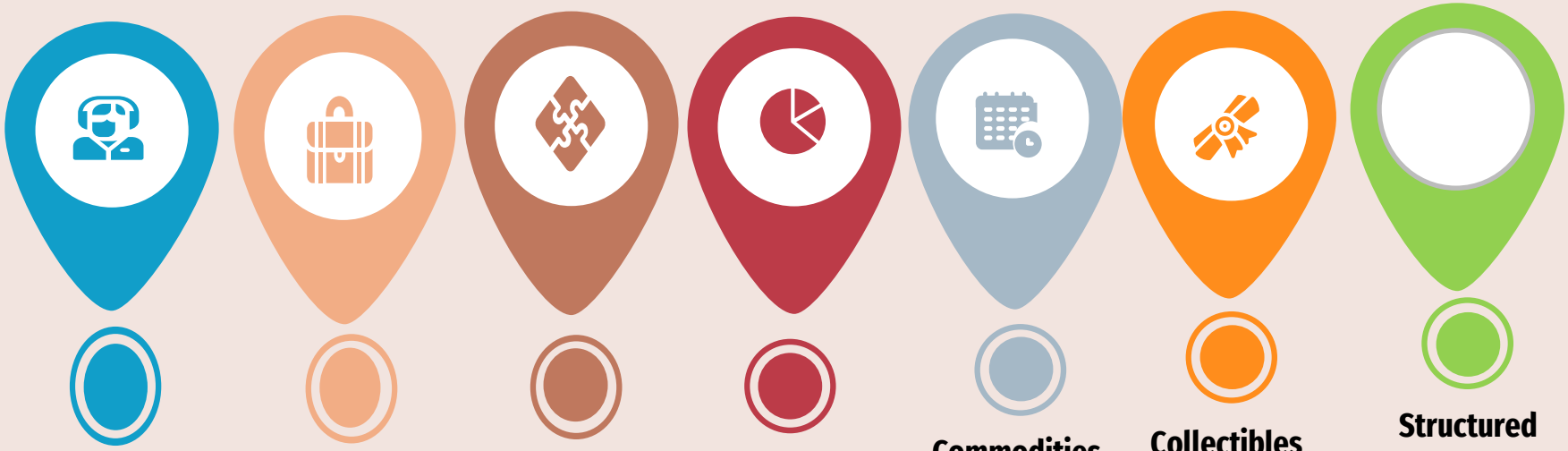
MANAGER SELECTION AND AIMS



Manager selection refers to the process of evaluating and researching investment manager strategies and/or creating a portfolio of investment manager strategies. Manager selection is a critical step in implementing any investment program. Even though investment objectives may be finalized and targets for asset class weights set, an investment plan is not productive until it is implemented through the purchase or sale of securities, properties, commodities, and derivatives.

Goldman Sachs Alternative Investments & Manager Selection Group is an investor in private equity funds. The firm provides investors with investment and advisory solutions, across leading hedge fund managers, private equity funds, real estate managers, public equity strategies fixed income strategies and ESG integrated and impact investments. The AIMS Group manages globally diversified programs, targeted sector-specific strategies, customized portfolios, and a range of advisory services. The company's investors access opportunities through new fund commitments, fund-of-fund investments, strategic partnerships, secondary-market investments, co-investments, and seed-capital investments.

ALTERNATIVE INVESTMENTS



Private Equity

capital investment made into private companies, or those not listed on a public exchange

Private Debt

investments that are not financed by banks (i.e., a bank loan) or traded on an open market

Hedge Fund

investment funds trading relatively liquid assets employ various investing strategies with the goal of earning a high return

Real Estate

real estate is the most common type and the world's biggest asset class

Commodities

considered a hedge against inflation, as they're not sensitive to public equity markets

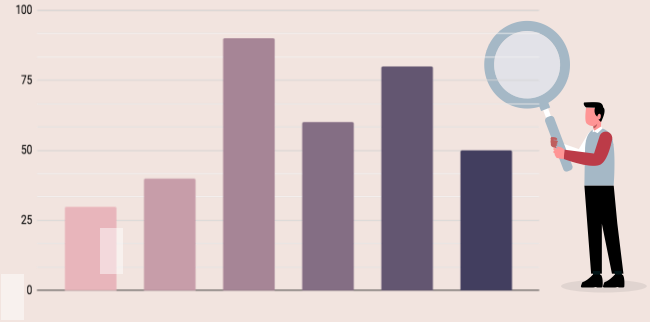
Collectibles

Investing in collectibles means purchasing and maintaining physical items with the hope the value of the assets will appreciate over time

Structured Products

involve fixed income markets—those that pay investors dividend payments like government or corporate bonds—and derivatives, or securities

GENERALIZED QUANTITAIVE FRAMEWORK



Rank based on performance
This is the heart of our framework.
Now that we have funds in distinct categories, our job is to be able to rank them in order of performance.
The guiding philosophy that this framework follows can be summed up in a single sentence – "**Long-term track record of consistent performance**".

Following this philosophy, the entire ranking process can be broken down into 3 parts:

1.Long-term performance with respect to peers and consistency of that performance
2.Overall risk associated with the fund
3.Recent performance
In other words, we are looking for managers that exhibit strong risk adjusted returns or those that have outperformed with low volatility.

TRADITIONAL/BASIC APPROACH

The indicators of investment risk that apply to the analysis of stocks, bonds, and mutual fund portfolios are listed below. These statistical measures are historical predictors of investment risk/volatility and they are all major components of modern portfolio theory(MPT).

1. **Alpha** is a measure of an investment's performance on a risk-adjusted basis. It takes the volatility (price risk) of a security or fund portfolio and compares its risk-adjusted performance to a benchmark index.

   Alpha = R – R_f – beta (R_m-R_f)

R represents the portfolio return
R_f represents the risk-free rate of return
Beta represents the systematic risk of a portfolio

An alpha of 1.0 means the fund has outperformed its benchmark index by 1%. Correspondingly, an alpha of -1.0 would indicate an underperformance of 1%. Higher the alpha of the manager, the better. **We use the overall level of Alpha over time as an indicator of manager skill.**
Rolling Alpha > 0

2. **Beta**, also known as the beta coefficient, is a measure of the volatility, or systematic risk, of a security or a portfolio, compared to the market as a whole. Beta is calculated using regression analysis and it represents the tendency of an investment's return to respond to movements in the market. By definition, the market has a beta of 1.0.

Beta=Variance/Covariance

where: Covariance =Measure of a stock's return relative to that of the market

Variance=Measure of how the market moves relative to it's mean

For example, if a fund portfolio's beta is 1.2, it is theoretically 20% more volatile than the market.

3. **R-squared** is a statistical measure that represents the percentage of a fund portfolio or a security's movements that can be explained by the movements in the benchmark.

$$\textbf{Correlation Coefficient} = \Sigma [(X - X_m) * (Y - Y_m)] / \sqrt{[\Sigma (X - X_m)^2 * \Sigma (Y - Y_m)^2]}$$

Where:

X – Data points in data set X

Y – Data points in data set Y

$\mathbf{X_m}$– Mean of data set X

$\mathbf{Y_m}$– Mean of data set Y

4. **Expense Ratio** (ER), also sometimes known as the Management Expense Ratio (MER), measures how much of a fund's assets are used for administrative and other operating expenses. An expense ratio is determined by dividing a fund's operating expenses by the average dollar value of its assets under management(AUM). Operating expenses reduce the fund's assets, thereby reducing the return to investors.

ER=Total Fund Assets/Total Fund Costs

5. **Information Ratio** (IR), is a measurement of portfolio returns beyond the returns of a benchmark, usually an index, compared to the volatility of those returns. The benchmark used is typically an index that represents the market or a particular sector or industry.

6. **Standard deviation** is a statistic that measures the dispersion of a dataset relative to its mean and is calculated as the square root of the variance. The standard deviation is calculated as the square root of variance by determining each data point's deviation relative to the mean. It gives us an estimate of the volatility/risk.

7. **Downside deviation** is a measure of downside risk that focuses on returns that fall below a minimum threshold or minimum acceptable return (MAR). It is used in the calculation of the Sortino ratio, a measure of risk-adjusted return. Downside deviation can also tell you when a "risky" investment with a high standard deviation is likely safer than it looks.

8. **Maximum drawdown** (MDD) is the maximum observed loss from a peak to a trough of a portfolio, before a new peak is attained. Maximum drawdown is an indicator of downside risk over a specified time period.

$$MDD = Trough\ Value - Peak\ Value / \text{Peak Value}$$

9. **Sharpe ratio** is the average return earned in excess of the risk-free rate per unit of volatility or total risk. Volatility is a measure of the price fluctuations of an asset or portfolio. A high Sharpe ratio is good when compared to similar portfolios or funds with lower returns. The Sharpe ratio has several weaknesses, including an assumption that investment returns are normally distributed.

$$Sharpe\ Ratio = \frac{R_p - R_f}{\sigma_p}$$

where:

R_p = return of portfolio

R_f = risk-free rate

σ_p = standard deviation of the portfolio's excess return

10. **Sortino ratio** is a variation of the Sharpe ratio that differentiates harmful volatility from total overall volatility by using the asset's standard deviation of negative portfolio returns downside deviation instead of the total standard deviation of portfolio returns.

$$\text{Sortino Ratio} = \frac{R_p - r_f}{\sigma_d}$$

where:

R_p = Actual or expected portfolio return

r_f = Risk-free rate

σ_d = Standard deviation of the downside

11. **Treynor ratio**, also known as the reward-to-volatility ratio, is a performance metric for determining how much excess return was generated for each unit of risk taken on by a portfolio. A higher Treynor ratio result means a portfolio is a more suitable investment

$$\text{Treynor Ratio} = \frac{r_p - r_f}{\beta_p}$$

where:

r_p = Portfolio return

r_f = Risk-free rate

β_p = Beta of the portfolio

11. **Cash Flow at Risk** (CFaR), in the context of foreign exchange, is a measure of the extent to which future cash flows and operating profit margins may fall short of expectations as a result of currency fluctuations. CFaR calculations take into account the volatility of the currency pairs in the exposure and their correlation, in order to measure the cash-flow and/or operating margin impact of an adverse change in currency rates.

12. **Calmar ratio** is a gauge of the performance of investment funds such as hedge funds and commodity trading advisors (CTAs). It is a function of the fund's average compounded annual rate of return versus its maximum drawdown. The higher the Calmar ratio, the better it performed on a risk-adjusted basis during the given time frame.

13. **Internal Rate of Return** (IRR) is a metric used in financial analysis to estimate the profitability of potential investments. IRR is a discount rate that makes the net present value (NPV) of all cash flows equal to zero in a discounted cash flow analysis. Generally speaking, the higher an internal rate of return, the more desirable an investment is to undertake. IRR is uniform for investments of varying types and, as such, can be used to rank multiple prospective investments or projects on a relatively even basis.

$$0 = \text{NPV} = \sum_{t=1}^{T} \frac{C_t}{(1+IRR)^t} - C_0$$

where:

C_t = Net cash inflow during the period t

C_0 = Total initial investment costs

IRR = The internal rate of return

t = The number of time periods

Rolling Percentile Rank instead of Sharpe Ratio

Note that most of the Mutual Fund industry uses Sharpe ratio as one of the primary indicators of performance.
Sharpe Ratio, however, has a big limitation:
It is highly sensitive to the time period under consideration. This makes relative comparison between funds very difficult.

A solution to this is Rolling Percentile Rank.
It is fairly simple. We pick a start date (Jan 2004 in our framework) and look at every 3-year period starting Jan 2004 all the way up to Dec 2018.
So, 3rd Jan 2004 to 3rd Jan 2007 is one such period. Similarly, 18th Sep 2012 to 18th Sep 2015 is another such period and 31st Dec 2015 to 31st Dec 2018 will be the last 3-year period. In total, there are roughly 3,000 such periods.
Now, for each 3-year period, we rank the funds based on the returns delivered during that 3-year period.

We don't use absolute rank but percentile rank. For example, if there were 17 funds during a period, and a fund is ranked 4th, it's percentile rank would be 23.5%
To get a sense of the fund's "Long-term performance with respect to peers", the best way is to calculate the average rank over all periods.
While averaging gives us a sense of long-term performance, it doesn't tell us much about the consistency of the fund. Suppose we have 10 years of performance data for a fund. For the first 7 years, the fund was consistently ranked in top 10%. However, for the last 3 years, it is ranked in the bottom 10%.
Average ranking might still look good. But the performance cannot be termed as "consistent".
To measure consistency, we introduce another metric – percentage of times the fund has been in top 25%. Let's call it Top25 percentage.
We now have Long-term average percentile rank to measure long-term performance and Top25 percentage to measure consistency of that performance.

PRIVATE EQUITY

Private equity is an alternative investment class and consists of capital that is not listed on a public exchange. Private equity is composed of funds and investors that directly invest in private companies, or that engage in buyouts of public companies, resulting in the delisting of public equity. Institutional and retail investors provide the capital for private equity, and the capital can be utilized to fund new technology, make acquisitions, expand working capital, and to bolster and solidify a balance sheet.

A private equity fund has Limited Partners (LP), who typically own 99 percent of shares in a fund and have limited liability, and **General Partners (GP),** who own 1 percent of shares and have full liability. The latter are also responsible for executing and operating the investment.

Private equity funds have at least two key institutional features that differentiate them from traditional investments in traded stocks or bonds and make risk management a challenging task. First, private equity fund investments are illiquid and long term. Private equity funds typically have maturities of ten to fourteen years, and secondary markets for private equity fund positions are still highly inefficient, making it costly for investors to sell their positions. Second, private equity fund investments involve specific dynamics of capital drawdowns and distributions. The private equity fund investor first makes an initial capital commitment and later transmits specific amounts of capital to the general partner in response to capital calls (or capital drawdowns).

The timing and size of the capital calls are not known until they are announced, and usually there is a substantial lag between the time at which capital is committed to a fund and the time at which that capital is actually drawn for investment. In addition, cash payouts by private equity funds are also uncertain, although they are significant, because of the bounded life cycle of the funds. Thus, the invested capital changes dynamically over the lifetime of a fund, and private equity fund investments require active cashflow management of capital calls and distributions

CRITERIA FOR MANAGER SELECTION

Performance Track Record

As the most widely used --and presumably most important-- due diligence criterion, we put heavy emphasis on the analysis of the GP's performance track record. We calculate standard performance measures, such as IRR and Performance Quartiles, as well as the 'Delta IRR', i.e. the difference between actual IRR and the average IRR of a fund's same-vintage and same-stage peers. We considered either the 'latest mature' fund or the average of all prior funds.

Dealflow

Another important aspect to look at is the ability of a GP to generate an appropriate and stable flow of investments. This ability can be assed using two complementary measures. First, the Percent of Fund Size Invested (measured as of year 4 after vintage) for the 'latest mature' fund. This variable captures if the GP was able to find enough investments opportunities to invest the capital raised in the most recent mature fund. Second, the Variance in Number of Deals per year of the GP prior to focal fund vintage, which measures whether investments occurred regularly or in waves, where the latter could be interpreted as a possible indication of lower dealflow generation ability.

GP Experience

Experience is measured through two alternative variables. First the number of prior funds raised by the GP and second as the count of the number of prior investments made by the GP prior to the focal fund's vintage (incl. multiple investment rounds).

Differences between the focal and prior funds

The relevance of past performance as an indicator of future fund performance is expected to decrease if focal fund characteristics differ from those of previous funds. Particularly relevant in this context are changes in fund size. We capture this effect by including the Percentage Change in Fund Size between focal fund and latest mature predecessor fund in the analysis.

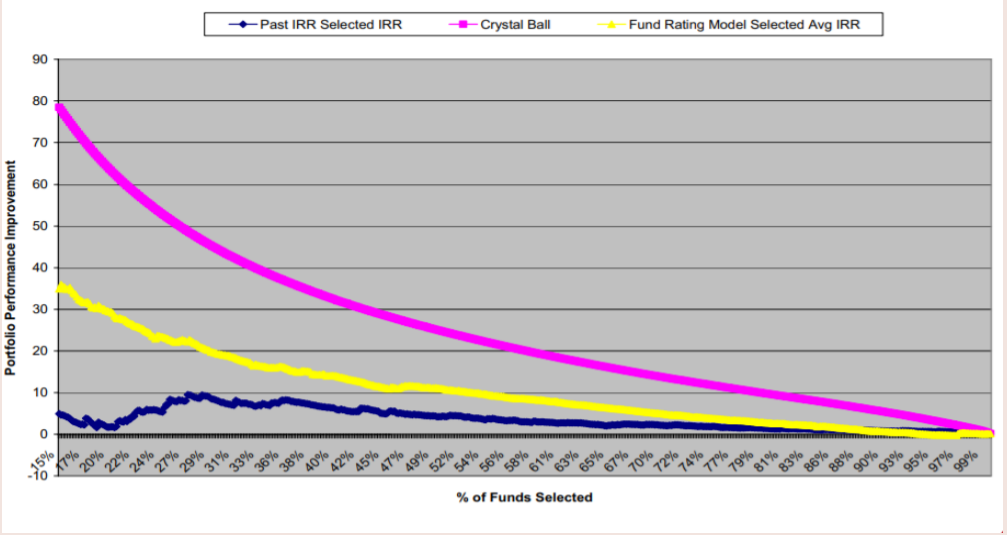
Correlation with Future Performance

A bivariate correlation analysis shown in Table 1 documents which of the different GP characteristics are significantly correlated with the ultimate performance (IRR) of the focal fund. Several observations are in order. First of all, we find support for the view that measures of past performance of a GP's funds (as of the vintage year of the focal fund) are strongly correlated with the subsequent performance of the next fund raised by this GP. Interestingly, measures of relative performance (Latest Mature Delta IRR, Overall Weighted Delta IRR, Overall Weighted Quartile) show stronger correlations than comparable measures of absolute performance (Latest Mature IRR, Overall Weighted IRR).

Random Choice vs Crystal Ball

First we determine the upper and lower ‘benchmark performance’ values for alternative fund selection rules.This lower bound benchmark corresponds to the return an LP would have enjoyed had she invested proportionally in all private equity funds offered – or in a random sub-set of those. Any efficient fund selection rule should be able to lead to an average performance above this value.To assess how efficient different criteria are, it is further important to assess the distribution of returns in the fund population. we need to know the aggregate performance of the best 10%, 11%, 12% of funds in the population and so forth. We determine these values by ranking all focal funds in the population by their end-of-life performance and plot the cumulative average performance of the best 10%, 11%, 12% etc. of these funds relative to the 17,13% average as the purple line in Figure 2.

The corresponding line can be interpreted as the result of a ‘crystal ball’ fund selection device through which an investor would have perfectly foreseen the future performance of each focal fund at its vintage and invested accordingly. This selection device is obviously impossible to realize, as the exact future performance of proposed funds is unknown. However it constitutes a good upper benchmark in terms of selection efficiency that alternative selection schemes can be compared to.



PERACS Private Equity Selection Efficiency Measure(PESEM)

We can use these previously developed upper and lower benchmarks to assess and compare the selection efficiency of different fund selection rules in the following way. If we take a given criterion (for example past performance) and apply it to the historic data to select, for example 20% of the overall population we can compare the average performance of this choice to the true top 20% of the entire population. PESEM allows us to comprehensively quantify and compare the selection efficiency of different fund selection methods. The PESEM can be interpreted as follows: a PESEM of 50% enables investors (on average) to reach a level of performance improvement over the average portfolio equivalent to half the improvement that a true crystal-ball device would have generated.

$$PESEM = \frac{\int \text{AVERAGE PERFORMANCE OF ALL FUNDS} - \text{AVERAGE PERFORMANCE OF THE BEST X\% OF THE FUNDS}}{\int \text{AVERAGE PERFORMANCE OF ALL PE FUNDS} - \text{CRYSTAL BALL LINE}}$$

A slightly more sophisticated version of a past performance based selection scheme ranks all focal funds by the weighted average IRR of all their predecessor funds and invests into the top x% of funds according to this ranking. We assess the performance of the best 10%, 11%, 12% etc. of funds according to this list and plot the results as the blue line in Figure 2.
We note that surprisingly, selection schemes based only on past GP performance were historically not very efficient at identifying a high-performing portfolio.

Key to improving fund selection is the correct combination of multiple criteria. One concrete example is a proprietary fund selection model that has been jointly developed by the Due Diligence Advisory Firm PERACS and the European LP Feri Institutional Advisors.

It is based on a multifactor fund rating metric that combines different measures of Performance Track Record, Dealflow, GP experience and Differences between the focal and prior funds. We tested this model on the 615 historic fundraising events in our data and the selection rule increased portfolio performance substantially. The yellow line in Figure 2 compares the performance of the portfolio of the best x% of funds selected by this fund rating model to the performance of the crystal ball upper benchmark, as well as to the previously used past-performance-based selection results.

This multi-factor fund rating model has a PESEM of 35%, in other words it enables investors to reach a level of performance improvement over the average portfolio equivalent to 35% of the improvement that a crystal-ball choice would have generated.

Manager betas and “Factor Footprint”

The managers have been ranked on their regression R-square, which we will refer to as the overall “factor footprint” of each manager. The size of the factor footprint indicates how much the hedge fund managers’ returns may interact with the rest of the investor’s portfolio. All things equal, managers with smaller factor footprints are desirable because their returns are independent of the key risk factors that are included in the model. A small R-square in the four-factor model confirms that managers are not playing with standard risk factors or asset classes in a static fashion. To get a more detailed sense of the types of “bets” that these managers are making to generate their returns, qualitative due diligence and more elaborate risk factor models should be employed. If all “hedge” funds were truly “hedging” out their exposures to the dominant risk factors, one would expect to see a small factor footprint for all managers. This is, however, not generally the case

Evidence of persistence in performance measures and factor exposures Our approach to hedge fund portfolio construction relies on two crucial assumptions: Alpha persistence: The estimated measures of alpha should predict the relative performance of managers in the future. Beta persistence: The estimated risk characteristics should predict the managers’ future risk profile and betas (for instance, their equity beta).

MONITORING AND EXITING A PRIVATE EQUITY

Our investment and deselection process is both qualitative and quantitative. On the quantitative side, we benchmark against peer, broad market indices and other relevant risk and performance metrics. On the qualitative side, we rate the funds for their manager competency, transparency and conviction.

Because an investor's alternatives are more constrained than in the case of public investments due to possibly unfavourable exit values and limited control over managers, monitoring private equity fund investments may yield substantially lower rewards.
Nonetheless, monitoring is recommended, and limited partners might be useful in collaborating with fund managers.
Because the fund managers are likely to start a new private equity fund in a future vintage year, this monitoring activity can be q uite beneficial—especially when deciding which upcoming fund launches to contribute to.
PE firms buy businesses with the intention of selling them for more money than they put in.
A normal leaving period lasts between five and seven years.

Hedge Fund

Hedge funds are actively managed investment pools whose managers use a wide range of strategies, often including buying with borrowed money and trading esoteric assets, in an effort to beat average investment returns for their clients. They are considered risky alternative investment choices. Hedge fund strategies have historically been shown to deliver good risk-adjusted returns and further have proven to enhance the risk/ return profile of a generic portfolio of traditional assets.
Hedge funds require a high minimum investment or net worth, excluding all but wealthy clients.

The most attractive managers exhibit *statistically significant alpha and limited beta risk* with only small exposures to traditional risk factors. A ranking methodology based on these criteria allows us to select hedge fund managers that significantly outperform their peers out of sample.

Hedge funds are not a homogeneous asset class. There are a number of distinct strategies with differing risk and return characteristics. Even though there are some common features of individual hedge funds, the heterogeneity of performance as well as investment styles, even within the same strategy, is well known to hedge fund investors.

Persistence in Hedge Fund Performance

Hedge funds are frequently judged on the basis of their past performance. A rise in assets under management nearly invariably follows good past performance, whereas poor historical performance is punished.

We start with the simple monthly returns for a few given hedge funds to initially test for persistence in hedge fund performance. We divide the six year period into two sub-periods and calculate the average returns, standard deviations, and Sharpe ratios for each fund in two sub-period.

First, we use non-parametric contingency tables to test the hypothesis of whether or not returns, standard deviations, and Sharpe ratios display any persistence. In order to do this, we calculate the median values for all of the performance variables in each period and categorize each hedge fund as a winner (W) or a loser (L) based on its performance being better or worse than median performance for all the funds in the strategy type. We repeat this analysis for volatility by likewise defining a manager as a loser (winner) if his or her standard deviation is above (below) the median standard deviation of the managers within the same strategy. Similarly, if a manager's Sharpe ratio is greater (less) than the median Sharpe ratio of the managers within the same strategy, the manager is categorized as a winner (loser). The decision of winner or loser is based on a presumed risk-averse investor's utility function that prefers higher return and lower risk. Persistence exists, if a winner (loser) in the first subperiod as defined above continues to be a winner (loser) in the second sub-period. Formally, we test the hypothesis of persistence by using contingency tables and a cross-product ratio (CPR) as in Kat and Menexe (2003). The CPR as defined below captures the ratio of the managers that show persistence to the managers that do not

$$CPR = (W1W2 * L1L2) / (W1\ L2 * L1W2)$$

where W1 is the winner in the first sub-period,W2 is the winner in the second sub-period,L1 is the loser in the first sub-period, and L2 is the loser in the second sub-period. Therefore ifa manager isa winner during both sub-periods, he/she will be labeled as W1W2,etc.Under the null hypothesis of no persistence the CPR so defined equals 1.In other words,when there is no persistence one would expect each of the four categories denoted by W1W2, W1L2, L1L2, and L1W2 to have 25% of the total number of the funds.

The significance of CPR is tested by a Z-score, which is the ratio of natural logarithm of the CPR to the standard error of first of the natural logarithm of CPR and is calculated as follows:

$$\sigma = \sqrt{\frac{1}{W1} + \frac{1}{W2} + \frac{1}{L1} + \frac{1}{L2}}$$

where σ is the standard error of the natural logarithm of the CPR and the

Z score = ln(CPR)/σ

When the Z-score is greater than 1.96, the null hypothesis of no persistence is rejected at a 5% level of significance. The contingency tables, CPRs, and Z-scores to test the persistence in returns, standard deviations, and Sharpe ratios of the managers of the seven hedge fund strategies for the three-year sub-periods previously defined are observed. Results show that none of the strategies display statistically significant persistence in their returns or Sharpe ratios. However, we find much more persistence in standard deviation.

In summary, we find strong evidence of persistence (with further help of regression analysis and R-score) in risk profiles and no evidence of persistence in returns and Sharpe ratios of hedge fund managers.

A glaring weakness in the analysis above is that little attention is devoted to individual strategy returns. We address these issues by extending the contingency table analysis by re-defining a winner or a loser in relation to an excess or deficit return over a stylized hedge fund benchmark. Specifically we define the manager as a winner (loser) if his or her return is better (worse) than the respective strategy index return, if s/he is less (more) volatile than the strategy index, or if his or her Sharpe ratio is better (worse) than the Sharpe ratio of the index. The results of this confirm the previous analysis when the peer group median is used to define a winner or a loser. In summary, these results imply that the simple use of the performance history of a manager is of very little use in estimating future returns or future risk adjusted returns ;by comparison the historical risk profile as represented by the volatility is in general quite valuable in estimating future volatility. This is of great consequence for both portfolio construction and for manager selection and argues for a risk budgeting approach to either.

QUANTITATIVE ALPHA GENERATION ESTIMATION

We found no evidence of persistence in returns for the managers in the hedge fund strategies covered using a methodology that compares returns to some defined median return as described above. However we note empirically that some managers appear to demonstrate some degree of internal performance persistence. The challenge for quantitative manager selection is to identify these persistent managers.

The approach we take is to examine the problem of persistence directly, and not define it by some relative return. An approach that makes no assumptions on either the nature of the return distribution or relative value of returns is the Hurst exponent. The Hurst exponent is a measure of whether a trend (negative or positive) will persist or mean revert to some historical average. The Hurst exponent H makes no assumptions about the frequency distribution of the underlying data and can be formulated as follows:

$$\mathrm{R}S_t = (ct)^H$$

where is $\mathrm{R}S_t$ the range of cumulative deviations from the mean divided by the standard deviation. H as defined above is the Hurst exponent and varies between zero and one. In this derivation a Hurst exponent of 0.5 corresponds to manager performance that is truly random: for example with returns in a given period completely independent of returns in the previous period. An exponent such that $0.5 < H \leq 1$ describes performance that is persistent. We note that persistence as defined by this criterion relates to persistence of either negative returns or positive returns. Finally, we note that an exponent such that $0 < H \leq 0.5$ describes anti-persistent or mean reverting manager performance. Anti-persistent performance implies that a period of poor performance will generally be followed by a period of good performance and vice versa.

We divide the six-year time period into two three-year sub-periods and repeat the methodology of the previous section, only this time using the Hurst component as the determiner of persistence. For the purpose of clarity we define the first sub-period as the in-sample development period and the second sub-period as the out-of-sample validation period. The process is then as follows. First, we calculate the Hurst exponent for managers in our database by using the three-year performance data in the in-sample development period. We then rank the managers based on their Hurst exponent, and create three groups. These groups are the low Hurst, the medium Hurst, and the high Hurst. In general, none of the groups are strategy specific and all of the strategies are represented in all groups.

The final part of this analysis is to then construct the returns of these Hurst portfolios in the out-of-sample period or validation ,i.e., the three years following the in sample selection period, and then investigate the returns for evidence of persistence. We construct three portfolios by giving equal weights to each manager in each group. During the in-sample development period, we do not see any significant distinction in returns, standard deviations, and Sharpe ratios; however, the number of consecutive months with up or down performance—another measure of persistence— increases from low to high Hurst portfolio. When we analyze the results within the out-of-sample validation period, we see that the high Hurst portfolio has the highest rate of return with the lowest volatility, and therefore the highest Sharpe ratio. Equally the high Hurst portfolio demonstrates the lowest maximum drawdown, the highest Calmar ratio, the largest number of up months, and the highest number of months with consecutive gains.

Findings show that during the out-of-sample validation period, portfolios containing persistent managers significantly outperform portfolios with managers having little or no persistence. It would therefore appear conclusive that one should in general prefer managers with relatively higher Hurst exponents.

As the next step, we further analyze the high Hurst managers and, given the importance we place on capital conservation, eliminate those with high downside risk. To define this parametrically, we use the D-statistic, which compares the value and frequency of a manager's losing months to his or her winning months. This statistic makes no assumptions about a manager's return distribution and is therefore particularly suitable for this asset class. The D-statistic is defined as follows:

$$\mathrm{D-Statistic} = \frac{sum|negative\ returns|}{sum|all\ returns|}$$

The D-statistic thus defined ranges from 0 to 1,with D = 0 representing a return distribution with no downside risk and D = 1 representing one in which a manager has no positive returns. We therefore are predisposed to managers with low D-statistics.
The low D portfolio also has the highest Sharpe ratio, lowest maximum drawdown, the highest Calmar ratio, the highest number of up months, and the highest number of months with consecutive gains.

These results indicate that a pure, non-relative, measure of persistence such as the Hurst exponent, in combination with a downside risk measure such as the D-statistic to filter negative persistence, is a very powerful tool for selecting managers with consistently good performance and generally lower volatility and downside risk.

T-Alpha

The estimated alpha, â, for each manager, the t-statistic of the estimated alpha, as well as the manager's appraisal ratio or risk-adjusted alpha. The managers have been ranked according to the t-statistic of their estimated alpha. This statistic is important because the magnitude of T-alpha measures the "significance" of the manager's alpha. A value above 1.645 suggests that the manager has been able to generate persistent positive alpha over time (it is significant at a 5% significance level). A value below this threshold suggests that the manager's actual alpha may be zero or even negative.

In our randomly selected sample of 24 hedge funds more than half of the managers have "insignificant" estimated alpha (i.e., T-alpha <1.645) and six of the managers have negative estimated alpha. These managers have failed to generate the positive, un-correlated returns that are required to improve the hedge fund investor's overall risk-return profile. The hedge fund investor may consequently want to evaluate whether their fees are justified and reconsider the allocation to these managers.

$$T_{(alpha)} = \frac{\hat{a}}{std(\hat{a})}$$

MONITORING OF HEDGE FUND

Risk analysis at a general level should include monitoring variables such as value-at-risk, conditional value-at-risk, and performing stress tests at both fund and aggregate levels. At a more specialized level, idiosyncratic risk such as optionality, liquidity, and spread blowout risk should be tailored to the individual strategy. However, we describe a measure called “Omega” that was recently developed by Keating and Shadwick [2002].In addition, Murphy [2002] suggests that widely used statistical measures of investment risk have significant limitations and introduces Omega to capture higher levels of information. Omega is applied to the performance history and monitors the ongoing profile of a fund’s risk over time at a level that takes into account the distribution of returns unlike “average” value measures such as volatility. We further find this measure to be particularly sensitive to the investor utility function and therefore effective in determining redemption risk. Omega can be calculated as follows:

$$\Omega(L) = \frac{\int_b^L (1-F(r))dr}{\int_a^L F(r)dr}$$

where L is the required return threshold, a and b are the return intervals, and F(r) is the cumulative distribution of returns below threshold L.

Omega involves partitioning returns into loss and gain above and below a required return threshold and then considering the probability-weighted ratio of returns above and below partitioning. It therefore employs all the information contained within the return series. In the discrete case, with equal frequency, we can write:

$$\Omega(L) = \frac{\sum_a^b Max(0, R^+)}{\sum_a^b Max(0, |R^-|)}$$

where R positive (negative) is the return above (below) a threshold L.

In this convention, therefore, high Omegas are to be preferred to low Omegas at equal points of the threshold.It is important to note that in keeping with the philosophy of this article the Omega function is equivalent to the return distribution itself, rather than being an approximation of it.

Unlike moment information, it does not lose any information and is therefore as statistically significant as the return series itself. No assumptions about distribution function, risk preferences, and utility function are necessary. By definition, since it contains all higher moments, it is particularly well suited for the performance measurement of hedge funds in a very elegant fashion.

Omega measure reveals all the information contained within return series, and is very useful in identifying changes in a manager's risk profile and performance. This would be an especially helpful tool for the ongoing monitoring process, since the purpose of that process is to capture any changes in a manager's risk profile and performance attributes.

We also argue for the use of logit-type modeling to determine the factors that point to fund viability and extract several factors from a database of liquidated funds. Finally we note the use of the Omega function to address the fund state that returns, standard deviation, downside deviation, Sharpe, Sortino, and Calmar ratios, maximum drawdowns, Omega, and number of down and up months should be analyzed, and benchmark and peer group analysis should be employed as a part of the due diligence and ongoing monitoring process. We believe that funds of funds that have a well-defined and disciplined manager selection, due diligence, and ongoing monitoring process should outperform their peers and benchmarks.

EXITING A HEDGE FUND

Performance is reviewed monthly. We will contact portfolio managers of funds whose returns vary dramatically from their benchmark or category average, asking the manager to explain the fund’s performance variance in detail. While we would not remove a fund based on short-term underperformance, it’s imperative that we understand why a fund’s returns are lagging. We are equally concerned with funds that exhibit exceptionally strong performance as this may be an indication that the portfolio manager is assuming too much risk to generate excess returns.

Results show that, in the absence of transparency, it is not always easy to spot funds that are in trouble and may eventually liquidate by simply looking at monthly returns. These findings suggest that, in addition to monthly performance data, regular transparency into the manager's portfolio and communications is essential for detecting distress. In particular, we would add issues related to the stability of credit lines as per analysis in De Souza and Smirnov to the results of the logit analysis presented in the previous section, which identified a variety of factors relevant to the stability of client capital such as poor performance, short lockup periods, and short redemption notice as criteria pertinent to liquidation.

CONCLUSION

Investors' goals and objectives influence manager selection, and as a result, the investment policy statement should incorporate a process for manager selection. Several theories relevant to manager selection are reviewed. These include the arithmetic of active management, which illustrates that before costs, the average manager will earn average returns. A review of the efficient market hypothesis, the costs of implementing active management, and research evidence reveals that it is very difficult to earn positive net alpha. As a result, before implementing an asset allocation policy, investors must decide whether they believe superior managers exist and whether they can identify them in advance. As an alternative to active management, indexing can provide exposure to many but not all asset classes. Like active management, indexing incurs costs and its effective implementation requires diligence. Asset allocation policy affects the manager selection process. For example, decisions regarding investing in public and private equities influence the level of resources required to conduct effective manager selection. The optimization of the expected utility of active returns is introduced as a technique to determine weights, and its application is illustrated with the use of historical data. This technique demonstrates that managers can be attractive because of their alpha potential and their diversifying characteristics. Performance measurement, performance attribution, and incentive fee structures are all major factors. Performance fees commonly improve the alignment of interests between investors and managers but can also lead to unintended incentives.

In a portfolio context, investors consider the portfolio risk, the portfolio return, and the relationship between the two. Because returns on alternative investments are less than perfectly correlated with returns on traditional investments, they have the potential to provide diversification benefits, decreasing portfolio risk. This has been a primary reason for investors to include alternative investments in their portfolios.

The ability of alternative investments to increase portfolio returns has been called into question for two reasons. One is that returns measures for alternative investments may be less reliable than returns measures for traditional investments. Another is that risks specific to alternative investments may increase their returns. Some of the returns may be explained by lack of liquidity, lack of transparency, and the risk incurred by the need to evaluate and select specific categories of alternative investments and select specific managers. Higher returns may also be explained by inefficiencies in valuations of alternative investments that can be exploited by a skilled manager. Overall, alternative investments have the potential to improve the risk-return characteristics of a portfolio.