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Integrating Hedge Fund Strategies in Sovereign Wealth Portfolios

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Abstract[1]

Sovereign Wealth Funds ("SWFs") differ in many ways from other institutional investors in their investment activities. They have different objectives, investment processes, time horizons, risk profiles, utility preferences as well as eligible instruments. One of the more recent debates within these funds revolves around considerations involving investing in hedge funds. Integrating hedge funds into portfolios has been difficult to do in a rigorous manner because the asset allocation technology that is available to many investors is ill equipped to handle the complexities that this asset class presents. Traditional approaches to asset allocation, portfolio construction, risk management and investor governance are quite inadequate for this task. This paper highlights issues that are specific to hedge fund investing and suggests new approaches to portfolio management.

[1] Kenneth Acuña and Sapna Vir provided valuable editorial assistance.

SUMMARY

This paper demonstrates Citi Capital Advisors' (CCA) research driven insights in asset allocation, manager selection and portfolio construction in alternative assets for sophisticated SWFs. It addresses the specific challenges of integrating hedge funds in SWF portfolios in a structured manner.

SWF Interest in Hedge Funds. SWFs have historically invested in a broad range of asset classes. In our estimation, around $200-300 billion is invested in alternative investments, mainly in private equity, infrastructure and in private real estate. However, over the last few years, an increasing number of SWFs have started making allocations to hedge funds. We estimate that around $25 billion of total SWF wealth is now invested in hedge funds and expect this number to continue to grow.

SWF investors are increasingly drawn to the returns enhancement and the risk reduction potential of this asset class[2]; many hedge fund strategies have been less volatile than investing approaches that simply take passive exposure to equity or to fixed- income market factors. Investing in some hedge fund strategies has also produced higher returns per unit of risk than investing in traditional assets such as stocks, bond and cash. Moreover, investors have begun to increasingly realize that properly constructed portfolios of hedge funds provide significant diversification benefits – as many strategies have exhibited low correlation with both traditional fixed- income and equity investment classes across a variety of economic cycles.

Hedge fund strategies, when chosen and combined properly, can be used to quickly take on or reduce market exposure (using short biased strategies). They have also proven themselves to be a good vehicle for implementing tactical market calls and gaining selective exposure to temporary market inefficiences. Many strategies have exhibited both lower drawdowns (period of negative returns from peak to trough) and faster recoveries than traditional passively managed investments. The better hedge funds are actively managed and run by managers whose incentives are aligned with investors. These funds generate significant risk adjusted returns by skillfully exploiting their chosen opportunity set. These funds have delivered attractive returns allowing investors to participate in bull markets while protecting them in bear markets. Investing in hedge funds thus has the potential to enhance stability of returns as well as provide outperformance. Of course, these benefits cannot be guaranteed and investing in alternatives carries a degree of risk.

Integrating Hedge Funds into Portfolios. Asset allocation with traditional investments has been well-studied over the last four decades. Markowitz's classic mean-variance approach is widely used for asset allocation for traditional assets and many asset allocation tools and models have been built around this framework, all of them predicated on a set of implicit assumptions. However, the increasing use of alternative investments has fundamentally challenged these traditional assumptions. Integrating hedge funds into portfolios is difficult to do in a rigorous manner because the traditional approaches to asset allocation, portfolio construction, manager selection, and risk management are ill equipped to handle the complexities that this asset class presents.

Organization of this Paper. This paper recognizes the differences in different SWF objectives which shape the asset allocation process and focuses on the specifics of hedge fund investing from a portfolio construction perspective. In doing so, it examines data issues, performance and benchmarking issues and provides both theoretical and practical insights into portfolio construction when making allocations.

The paper is organized in a series of sequential logically related parts which build upon preceding sections.

SWF Objectives. We introduce SWFs' and central banks' investing objectives. This provides the context for later sections on asset allocation, manager selection, portfolio construction and performance management.

Active Management. Since hedge funds are actively managed investments, we explore the role of active management in a portfolio context and highlight the asset characteristics of popular hedge fund strategies. This sets the stage for delving into asset allocation approaches for hedge fund strategies.

[2] According to Preqin's survey of 55 SWFs, 38% of all SWFs now invest in hedge funds. 63% of SWFs that are located in Middle East invest in hedge funds though this figure is just 31% for Asian SWFs.

Asset Allocation. In this section, we highlight four broad approaches for hedge fund asset allocation – extensions of the mean-variance framework, Taylor series expansion models, models that embed simulation techniques along with newer models that consider higher moments return distributions and optimize across mean-variance-skewness-kurtosis – and share examples of some such models and describe the general methodology to implement them. We also discuss data challenges associated with hedge fund allocation such as measuring and forecasting true risk, quantifying and incorporating the effect of illiquidity and tradability restrictions, reporting bias, information asymmetry, serial correlation, strategy drift as well as address unique risks posed by active management.

Manager Selection and Portfolio Construction. We describe the manager selection process using both qualitative and quantitative techniques and provide a framework for optimally combining managers into portfolios.

Performance Management. We examine benchmarking, performance management and manager monitoring issues in this section. We highlight the importance of rationalizing for both benchmark volatility and benchmark correlation to make meaningful comparisons between managers as well as derive true performance with respect to the benchmark.

Convergence. We conclude the paper with a discussion on new trends in alternative investments – the convergence of public and private equity and emergence of the multi-asset management firm.

We hope you enjoy reading this paper and invite you to have further conversations with us on these issues at Citi Capital Advisors.

INTRODUCTION

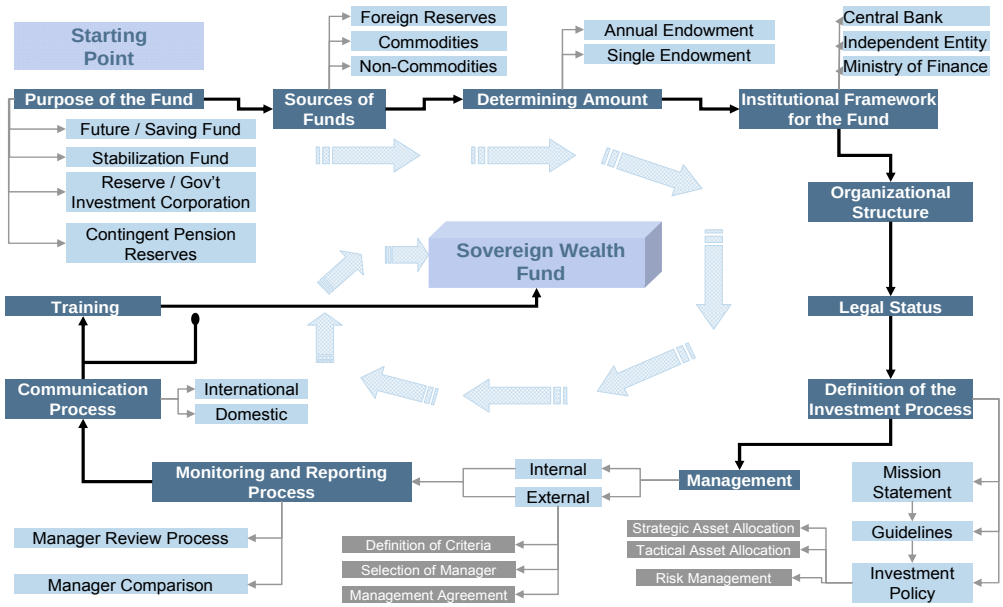
There is no universally agreed upon definition of what exactly constitutes a SWF, though the IMF definition is being increasingly accepted. According to this definition there are around 69 SWFs.[3] A stricter definition suggests that a SWF is a fund owned directly by a national government and is managed independently of other state financial institutions or government sponsored pension plans. It has no explicit liabilities and its sole orientation is essentially an economic one; it makes its investment decisions to pursue commercial returns by investing in a range of international risky assets. We estimate that around 38 funds from 25 nations meet these criteria and collectively manage around $2-3 trillion.

Strong economic conditions until 2007 sharply boosted energy and commodity prices as well as export led growth. Based on IMF data, global reserves tripled from $2.1 trillion to $6.2 trillion between December 2001 and October 2007. The bulk of the increase has been concentrated in the developing world; developing countries as a whole accounted for more than 80 percent of global reserve accumulation. Many of the fast developing countries already had SWFs, while others created them and funded them through transfers of excess central bank reserves. They, through their SWFs, in effect, became net capital exporters to advanced economies.

SWFs

There are many types of SWFs depending on their primary mandates. They exhibit a wide range of continuously evolving investment objectives, investment time horizons and risk appetites. Some SWFs invest purely to achieve financial returns and portfolio diversification while others have a broader economic or social agenda. The majority, 30 of the 38 large funds, have been established by commodity-exporting countries explicitly for savings and / or stabilization purposes.

Figure 1: SWF Objective, Funding, Organization and Investing Process



Source: Citi

[3] www.imf.org. According to the IMF, "SWFs are special purpose public investment funds, or arrangements. These funds are owned or controlled by the government, and hold, manage, or administer assets primarily for medium- to long-term macroeconomic and financial objectives. The funds are commonly established out of official foreign currency operations, the proceeds of privatizations, fiscal surpluses, and / or receipts resulting from commodity exports. These funds employ a set of investment strategies which include investments in foreign financial assets".

Savings Funds. Savings funds are typically funded by government budget surpluses, while the budget's expenditure path takes into account the long-term expected returns. For countries exporting nonrenewable resources, the principal challenge is to transform such resources into sustainable and stable future income streams. The major oil exporting countries in the Middle East, Norway, Russia, Nigeria, Venezuela and Indonesia have set up savings SWFs to invest oil trade surpluses in global financial assets. They typically aim at generating higher returns over a long time horizon and have higher risk tolerance profiles.[4] They tend to be more aggressive in their asset allocation and accord a higher weight to growth assets.

Savings SWFs, being long-term investors, tend to take advantage of mean reversion. Mean reversion, a tendency for bear markets to follow bull markets and vice versa, reduces risk for long-term investors but does not help short-term investors who must close their positions within a year or two. Thus risk-return ratios often look more attractive to long-term investors than to short-term investors. In fact, periods of "irrational exuberance" which drive up asset prices and reduce asset class risk premia can be periods in which individual assets are seriously mispriced in relation to one another. The progressive diversification of their portfolios into alternative asset classes further enhances their investment performance.

Stabilization Funds. A stabilization fund is a mechanism designed to reduce the impact of volatile fiscal revenues and / or foreign exchange receipts that are linked to the pro-cyclical pattern of export prices or volumes. Stabilization funds often take the form of contingent funds, which accumulate resources when government revenues or the price of exports is high (above some threshold) and disburse resources when they are low. Fiscal stabilization funds are typically funded from revenue contingent deposit rules (e.g., exceeding a revenue or commodity price reference level), and their withdrawal rules are crafted to finance specific budget deficits.[5] They generally invest in liquid, relatively secure assets as they tend to have a short-term investment horizon and more conservative portfolio allocations than savings funds. More recently, as a consequence of the financial crisis some SWFs are seeing their cash inflows diverted from their global portfolios to invest in their home countries / regions to add stability and economic stimulus to local markets. Some of these funds have explicit objectives to hedge against country-specific risks. They do so by exploiting positive or negative correlations between assets in their national balance sheet and marketable assets held in their hedge fund portfolios.

There are other types of government investment funds that operate much like SWFs do, but have other primary objectives.

Reserve Investment Corporations. They are established explicitly to increase the return on central bank reserves. They tend to have significant experience in fixed-income markets and often have limited capacity for investment in other asset classes, such as in hedge funds.

Government Investment Corporations. These are special purpose entities that aim to develop a broader base for economic growth. Some of these promote specific industries in which the fund's home economy can benefit from knowledge transfer. They may invest further along the risk-return spectrum than, say, sovereign Saving Funds. They often invest directly and purchase ownership stakes in entities.[6] They tend to purchase minority stakes directly from target companies, many of which are unlisted and often located in the fund's home country. The majority of investments in publicly traded companies are primary share offerings rather than open market share purchases.

Contingent Pension Reserves. These are set up to serve future social obligations which may be contingent unspecified pension liabilities on the government's balance sheet. Even though these do not have explicit liabilities they sometimes tend to have an asset liability management approach to investing.

Trends. There are very few studies that document sovereign wealth fund investment patterns and historical performance. The few studies that do exist, suggest that many SWFs departed from long-standing strategies and switched to riskier assets for higher returns following surges in oil prices. In the early 1990s, most SWFs were risk averse and chose to invest primarily in dollar-denominated

[4] Recently SWFs have started reducing their investment time horizons in response to market uncertainties and declines in reserve transfers. Some SWFs are also seeking indirect hedges in response to falling commodity prices. This may change the asset allocation strategy in SWF portfolios.

[5] For example, Chile's Fund for Social and Economic Stabilization smoothes government spending by putting aside fiscal surpluses in excess of a structural target, so as to be used in periods of weak terms of trade.

[6] The Monitor-FEEM SWF Transaction Database contains information on 1,158 direct deals completed by 17 SWFs in 11 countries for the period between 1981 and 2008.

US treasury bill holdings. Their role was mainly to support economic stabilization[7] when oil prices dove to about $10 a barrel. Then, in the late 1990s, Gulf Cooperation Council (GCC) governments decided to reduce their dependence on oil by diversifying their investments abroad, mainly in the United States and other Western markets. Their SWFs started investing in relatively riskier assets abroad, such as stocks and real estate. This trend gained strength as oil prices started to rise at the beginning of the new millenium. With oil prices rising further, the strategies of SWFs sought not just to support economic stability and investment diversification, but also to maximize returns, which drove many of them to undertake riskier investments. The recent oil price boom also led some SWFs to adopt a new approach, using part of their financial surplus to invest in industries that their governments perceive as particularly relevant for the development and diversification of their economies.[8]

Most SWFs follow an allocation approach aimed at balancing liquidity needs with a drive to achieve greater returns. Different investment funds allocate across the spectrum of asset classes from the least to the more risky; Asian and Gulf-based SWFs have invested in financial services, real estate, and the retail sector. In addition, these funds are increasingly considering the infrastructure sector, as the long-term profile of these investments fits with their long-term investment objectives. As the funds have continued to grow, the historical preference for US and European investments has changed in favor of more Asian and emerging markets investment. For the most part SWFs evaluate investments in a manner similar to other major asset managers, by choosing to invest primarily on the basis of economic opportunity, irrespective of sector or geographical considerations. The rapid growth of the funds, the shortage of available investment targets, and the increased willingness to take risk inevitably mean that investment strategies are continually undergoing change.

Investment Strategies. Empirical evidence on SWFs' investment activity, strategies and process is limited thus far due to many data restrictions. There is no uniform public disclosure of their assets, strategies, and governance structures.[9] Dividing these funds stylistically into two tranches (i) a liquidity tranche (ii) and an investment tranche helps to understand their investing style, albeit in a more generalized manner.

Liquidity Tranche. They are used primarily by commodity exporters to balance fluctuating revenue flows and to insulate the economy from inflows. This tranche tends to be more conservative in asset allocation with little to no exposure to alternative investments. Once the liquidity tranche is able to provide its stabilization role, current account surpluses often flow into the investment tranche.

Investment Tranche. These seek higher returns on capital by investing in riskier assets such as public equities and alternative investments. For the most part this tranche does not have to meet future liabilities or face redemption requests. They are therefore able to have a long-term investment horizon.

A discussion on SWFs is inevitably tied to the role of their country's central bank, since central banks provide them funding and excess reserve transfers.

Central Banks

According to the IMF, emerging and developing economies' central bank reserves are estimated at over $5.3 trillion in 2009. 80% of all reserves are now held by only 20 countries, 18 of whom have established SWFs, with the top five SWFs accounting for over 90% of total holdings.[10] Foreign reserves are a buffer for global policy imbalances and support currency intervention in foreign exchange markets. Liquidity and safety are thus paramount considerations.

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[7] The Kuwait Investment Authority emerged as the main driver of the country's rebuilding efforts in the aftermath of the first Gulf War.

[8] For example, Abu Dhabi's Mubadala Development Company, Dubai Investment Corporation, Temasek and Qatar Investment Authority have from time to time sought greater involvement in investing in companies that would help nation building.

[9] Best practices in investment governance have centered around having adequate systems and processes that address: (i) written investment objectives (ii) appropriate asset allocation strategy (iii) manager evaluation and research (iv) manager search and selection (v) ongoing oversight and evaluation of investment managers (vi) performance measurement reporting (vii) ongoing asset allocation advice (viii) process documentation.

[10] http://www.imf.org/external/research/index.aspx and Citi Capital Advisors (CCA) estimates.

Determining the right level of reserves is seldom easy and ideas about it have changed with the evolution of markets and crises of the past decades. For much of the post-war period, the rule of thumb was that international reserves should cover three-to-four months of imports.[11] Countries are now expected to have more reserves to protect against potentially large and disruptive capital flows, even if the exchange rate regime is floating. The "Guidotti Rule", that reserves should exceed short-term debt, is increasingly accepted as a important benchmark for assessing the adequacy of reserves – the rationale being that governments should be able to stay out of debt markets for new financing for "up to a year" if needed. Other factors to take into account include the exchange rate regime, the size and currency composition of the debt, trade flows, monetary aggregates and an assessment of risks, and structural aspects of the market. Taking these factors into account often raises the estimate of "optimal" reserves.

Overall, optimal reserve levels are not mechanically established and benefits associated with high reserve levels are hard to measure. As foreign exchange reserves have grown, many monetary authorities have concluded that their reserves are well in excess of their immediate needs and offer sufficient protection against sudden capital outflows. Excess reserves are sometimes defined as foreign exchange reserves in excess of both (i) the difference between actual foreign exchange reserves and the value of three months of imports; and (ii) the difference between actual foreign exchange reserves and total short-term external debt. Countries with large "excess reserves" (i.e., reserves in excess of traditional balance of payments needs) may opt for a more return and less liquidity-oriented portfolio allocation.

There is increased recognition that foreign currency reserves have an opportunity cost in terms of goods and services foregone. For a country that can borrow, the cost can be measured as the spread between the yield on liquid reserves and the external cost of funds.[12] That cost can be reduced through the active management of reserves, including investing in a range of higher yielding assets such as hedge funds through transfers to a SWF.

A number of central banks are expanding or considering expanding the range of assets they hold or the risks that they are prepared to accept. Many are adopting enhanced portfolio management techniques and considering increased allocation to "new" asset classes. Central banks are also increasingly interested in corporate paper, with some willing to hold corporate bonds with ratings above BBB. Diversification of currencies has also become a key element of best practice. Many are moving beyond core reserve currencies – US Dollar and Euro – to include other highly liquid currencies such as the Yen, Pound Sterling and Swiss Franc. These exposures are achieved either directly in the cash market or through a derivative overlay. In all such cases, risk management is crucial.[13]

Rapid growth in reserves permits central banks to shift focus from liquidity and preservation of capital to total return management. Many central banks have opted to "ring-fence" a portion of their foreign exchange reserves for other purposes, allocating a significant share to their SWFs. These investments are expected to create higher risk adjusted returns and reduce the opportunity costs of holding reserves. When levels of reserves exceed targeted levels, investment in more risky assets, such as what alternative investments are commonly perceived to be, at least on the margin, may make sense.

This has positive consequences for the hedge funds industry.

[11] The IMF estimates that the ratio of reserves to imports of goods and services for emerging and developing economies is at around 107% for 2009.

[12] Against these costs should be weighed the range of benefits of holding reserves, including self insurance through liquidity, the boost to government credibility (including through higher credit ratings), and the ability to discourage distortive capital flows and limit the propagation of shocks through the economy.

[13] The complex interactions that can occur during "extreme" events in certain types of alternative investments are difficult to model, but have to be considered. The increase in global volatility and recent unwinding of leveraged trades is a healthy reminder of the importance of strong risk management policies. Stress tests of major risks ("fat tail scenarios") such as hedge fund meltdown, as well as an understanding of the dynamic interactions among policymakers, markets, consumers and corporations, helps to anticipate issues before they occur. For central banks, reserves protect against market turbulence resulting from domestic political developments or natural disasters. Risk management in this context should encompass both direct and contingent obligations, including risks that arise from the restructuring of state owned enterprises, or restructuring and reform in the banking sector with a focus on liquidity at risk. Risk control and stress testing is an essential element of this best practice.

ACTIVE MANAGEMENT AND HEDGE FUNDS

There are three fundamental risk sources of portfolio returns[14], of which some risk sources ought to be compensated and others (those that can be diversified) ought not. These risk sources are:

Real Risk Free Rate of Return. Interest rate risk, which may reflect the interest rate sensitivity of long-dated liabilities is "uncompensated" risk in portfolios. This is because this risk may be hedged by holding some combination of bonds and / or interest sensitive derivatives such as interest rate swaps.

Returns from Undiversified Market Risk. This risk premium can be obtained for free usually. These are the returns that come from passive exposure to market fundamentals or "beta".[15] With efficient markets, the expected return per unit of risk for passive exposure to the market is relatively low. When markets are efficient – and all investors maximize a quadratic utility function where utility increases with expected return and decreases with increased risk - assets are compensated based on their beta instead of their volatility. This makes sense, for most idiosynchratic risks can be diversified away. Only the market risk has to be held, and therefore assets should be compensated only to the extent that they increase the risk of the market portfolio. Beta, in a sense, measures that marginal impact of increased holdings on the risk of the market portfolio.

Returns from Active Management. This is uncorrelated (or in practice less correlated) with the market. It is usually a small component of overall portfolios and has a low impact on overall portfolio risk. In equilibrium, the value of active management should be zero. The ability to generate positive returns from uncorrelated risk is not a market equilibrium phenomenon and acting on opportunities require deviations from equilibrium. This component of returns is difficult to find for it requires above average skill, and therefore, it justifies active management fees. Alternative investment managers, such as those who manage hedge funds, generate skills based returns, also referred to as "alpha",[16] and charge active management fees for doing that.

Table 1: Active Management is about Skills

Fundamental Returns	Skill-Based Returns
• Relatively consistent performance on risk adjusted basis	• Potentially higher or lower performance on risk adjusted basis
• Limited number of sources	• Large number of sources
• Moderate correlation to each other	• Potentially lower correlation to each other
• Higher confidence in projections	• Lower confidence in projections

Source: CCA

Market equilibrium is a theoretical construct. Markets, in the short-term, deviate from equilibrium and these deviations provide arbitrage opportunities for hedge fund managers. An asset with positive alpha is attractive as an investment since alpha can increase expected return without increasing the risk of a portfolio.

[14] A factor that complicates the understanding of portfolio risk is that different assets can contain many types of risks and different levels of portfolio aggregation can highlight different dimensions of risk. In fixed-income portfolios, for example, bonds are often decomposed into their individual cash flows in order to understand their interest rate sensitivity, a primary risk in fixed-income portfolios. In order to understand credit or stock specific risk, on the other hand, one may need to focus on the individual companies who have issued particular securities. In global balanced portfolios one may find the most important risks are exposures to different sectors, countries, or currencies. At the most aggregated level there are systematic risks, for example to war, or energy prices, inflation, or global economic conditions, that effect all markets. The point of bringing up these issues that complicate the understanding and measurement of risk is simply to motivate the simplification that comes from an equilibrium framework, which will be subsequently discussed.

[15] A quantitative measure of volatility of a security or strategy relative to a market index. An investment with a beta less than 1.0 is less volatile than the market, while an investment with a beta greater than 1.0 is more volatile than the market.

[16] A mathematical value indicating an investment's excess return relative to a benchmark. Alpha measures a manager's value-added relative to a passive strategy, independent of the market movement.

The equilibrium framework provides a context in which to identify securities that have alpha. Beta can be measured and an equilibrium expected return can be derived. If the expected excess return of an asset is above this hurdle rate, the difference is positive alpha. The job of active portfolio management or active investing in the case of hedge funds is to identify and capture such alpha in portfolios.

If the world is not in equilibrium, then there is an opportunity for skilled managers to create portfolios with positive alpha. Such alpha is incredibly valuable to investors. There are two ways to increase investor's expected return: either increase the exposure to market risk or find alpha i.e., expected return from uncorrelated sources of risk. The results can be dramatically different. Increased market risk significantly increases the risk of the portfolio and does not change the ratio of expected excess return to volatility. Adding alpha through active management, on the other hand, can dramatically increase expected return and has very little impact on portfolio volatility because of its lack of correlation.[17]

Investing in hedge funds is an easy way for SWFs to take on active management risk. Attributes of hedge funds include:

• Historically attractive absolute returns versus traditional asset classes

• Lower correlations that can provide protection in bear markets

• The potential to provide excess returns above the equilibrium hurdle rate

Hedge Funds are Active Managers. There are around 8,000 hedge funds which cumulatively manage over $1.5 trillion in assets across many different strategies.[18] Hedge funds are private investment vehicles, typically organized as limited partnerships, in which the investors are limited partners and the managers are general partners. As general partners, the fund managers usually invest into the partnership to ensure alignment of economic interests with investors. Investors are charged a management fee as well as a performance based fee. Hedge funds' special fee structures align managers' incentives with fund performance. Hedge funds deploy dynamic trading strategies, short-sell securities[19] and often leverage their bets. There is no single universally accepted taxonomy for hedge fund strategies, though investment styles and return characteristics are often used to distinguish between them. Some of the more popular strategies are described later on in this section.

Hedge fund strategies may be classified[20] into two broad categories: (i) non-directional and (ii) directional. Within this spectrum lie opportunistic event-driven strategies.

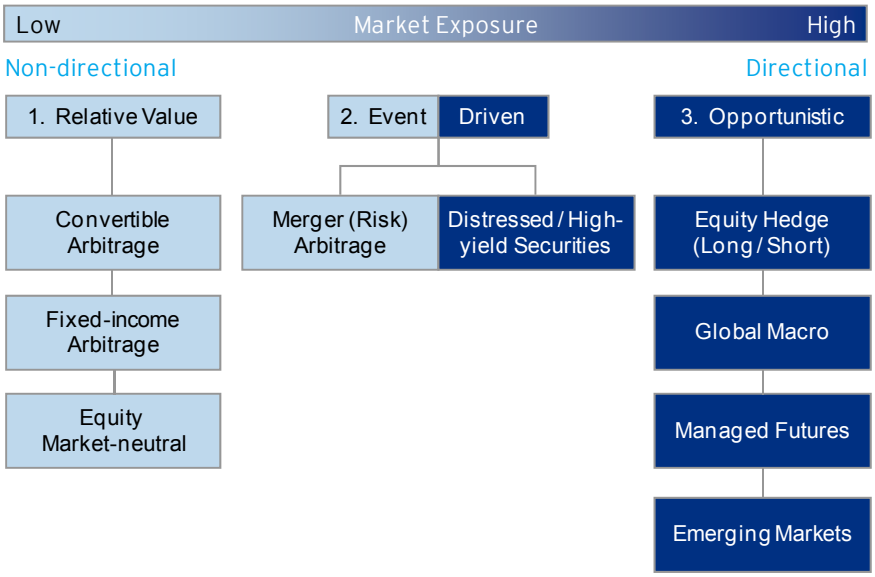
[17] The mathematics of risk are nonlinear and, in part, depend on a statistical measure called correlation.

[18] CCA estimates based on HFRI, Prequin, Eureka Hedge reports.

[19] Short-selling is the sale of borrowed securities with the intention of buying identical assets back at a later date to return to the lender. The short-seller hopes to profit from a decline in the price of the assets between the sale and the repurchase.

[20] Fung and Hsieh (1997) classify hedge funds on the basis of three key characteristics: location, strategy and leverage. The location identifies the markets in which they trade, as for example equity or bond markets. The strategy specifies the trading methods adopted by the managers to exploit arbitrage opportunities. And lastly, they distinguish hedge funds on the basis of the amount of leverage used.

Figure 2: Partial List of Hedge Fund Strategies



Source: AIMA

Non-Directional Strategies. They tend to neutralize a majority of market risk, largely assuming only the risks inherent to the individual securities. They attempt to extract value from a set of diversified arbitrage opportunities that aim to exploit structural anomalies in markets. The potential excess return from non-directional strategies emanates from identified mispricings among related securities held between the long and short positions. Consequently, security selection is critical for a non-directional hedge fund to achieve returns in excess of a benchmark.

Directional strategies. They take greater exposure to market risks in addition to their idiosyncratic risks. As a result, these strategies tend to be "net long" or "net short" of the market portfolio. In doing so, the funds are rarely independent of the risk factors that drive the returns of more conventional asset classes. They often invest in a variety of assets including stocks, bonds, commodities, index and interest rate futures, and currencies.

Within these broad classifications there are over 20 sub-classifications by strategy type. For instance, there are "event-driven" strategies which invest in positions on corporate events. Another example is "global macro", which commonly refers to funds that rely on macroeconomic analysis to take bets on the major risk factors, such as currencies, interest rates, stock indices, and commodities. "Market-neutral", in contrast, refers to funds that actively seek to avoid major risk factors, but take bets on relative price movements utilizing strategies such as long-short equity, stock index arbitrage, convertible bond arbitrage, and fixed-income arbitrage.

Common Strategies

To analyze hedge fund characteristics and constitute them into portfolios, we begin by recognizing the asset class' heterogeneity. In this section, we discuss some of the more popular trading strategies, their risks, and some statistical properties, particularly skewness[21] and kurtosis[22]. Subsequent to this, we address asset allocation issues.

Convertible Arbitrage. Convertible arbitrage is the purchase of a bond that has the option to convert into the common stock of the issuer at a predetermined price, should the stock price increase. This purchase is combined with the simultaneous short-selling of the related common

[21] Skewness is a statistical measure to capture asymmetry in the return distribution of an asset. If a time series of an asset has a negative skewness, this might indicate that there is an increased probability of negative returns, compared to a normally distributed time series. In other words, the historical pattern of returns does not resemble a normal (i.e., bell-curve) distribution.

[22] Kurtosis measures the degree to which exceptional values — those much larger or smaller than the average — occur more frequently (high kurtosis) or less frequently (low kurtosis) than in a normal (bell shaped) distribution. High kurtosis results in exceptional values that are called "fat tails." Fat tails indicate a higher percentage of very low and very high returns than would be expected with a normal distribution.

stock. The objective is to profit from a mispricing of the embedded equity option or credit spread of the issuer. The three important sources of convertible arbitrage risk are interest rate risk, credit risk and equity option risk. Although the upside potential of the trade is typically known with precision, the downside cannot be determined with certainty. A large downside risk exposure is intuitive because the issuing company can face potential liquidation or a large ratings downgrade, which can lead the convertible bond price to decline and cause the embedded option to be worthless. This strategy is expected to exhibit negative skewness and excess kurtosis.

Distressed Securities. Distressed securities managers invest in companies experiencing financial difficulties and make money once the security prices of these companies recover. The number of companies recovering from financial distress is lower in downward moving markets so the distressed securities strategy is expected to behave like a short put option on the market index. The primary involvement of hedge funds following a restructuring strategy is investing in the companies' debt securities. Thus, the upside potential is limited by the face value of the particular security. Distressed securities funds may face significant losses if companies are downgraded by rating agencies, go into default, or declare bankruptcy. Distressed hedge fund managers face significant event risk due to their credit risk exposure. The return distribution of this strategy sometimes looks similar to the return distribution of high-yield bonds. This strategy is expected to exhibit negative skewness and excess kurtosis.

Emerging Markets Equity. Emerging markets hedge fund managers generally seek to profit from investments in debt instruments and equities of emerging markets countries. These managers predominantly follow buy and hold strategies, because hedging with short-selling is often prohibited in these countries. Using derivatives for hedging purposes may also not be possible, because these instruments are often not available. Investments in emerging markets contain high return sources, but they are quite vulnerable to world economic downturns, recessions, or some of the other significant problems emerging market countries face. This strategy is expected to exhibit negative skewness and excess kurtosis.

Equity Market-Neutral. Equity market-neutral hedge fund managers seek equally long and short exposures to the equity market. Thus, these funds try to maintain a neutral risk exposure to the general stock market, as well as to countries, industries and currencies. The ideal equity market-neutral portfolio should not contain any market risk or systematic risk factors with respect to industries or currencies. The remaining source of return should be the pure skill for security selection. When all systematic risk factors are eliminated, we do not expect any negative skewness or fat tails. This strategy is expected to exhibit positive skewness and no excess kurtosis.

Event-Driven. Event-driven funds attempt to profit from the spread between the acquirer's bid price and the trading price of the target after the deal is announced. Thus, if the deal fails, the fund could pay a substantial premium. Event-Driven funds act like a short put option on the market index. This strategy's risk is based on non-realization of the anticipated event. For example, this may mean non-realization of mergers, takeovers, spin-offs, or reorganizations. The event-driven hedge fund is thought to have limited upside potential, because the spread is limited and the event risk is already partly reflected in the price. The downside risk, however, is larger, because of unlimited exposure in the case of non-realization. This strategy is expected to exhibit negative skewness and excess kurtosis.

Fixed-Income Arbitrage. Fixed-income arbitrage hedge fund managers seek to profit from relationships and mispricing between different fixed-income securities that are related either mathematically or economically. They purchase one "underpriced" fixed-income security while simultaneously selling another set of fixed-income instruments short in order to replicate perfectly. They then leverage their portfolio to increase expected gains, because the price discrepancies can be very small, and wait for convergence of the fixed-income security with the replication portfolio. There are, however, many things that can prevent this convergence. Fixed-income arbitrage hedge strategies do not depend on the direction of the general financial market. This strategy is expected to exhibit positive skewness and excess kurtosis.

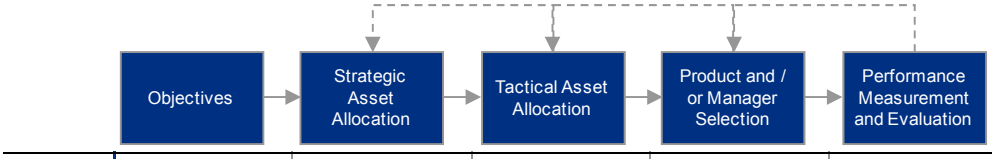
Global Macro. Global macro hedge fund managers seek to profit from long and short positions in any of the world's major capital markets, e.g., fixed-income, currency, equity, and commodity markets. Their broad investment mandate allows the creation of widely diversified portfolios with low remaining idiosyncratic risk to specific markets. This investment approach minimizes the probability of outliers, which reduces fat tails. Global macro managers have the ability to produce "alpha" with a low probability of negative outliers. This strategy is expected to exhibit positive skewness and no excess kurtosis.

Long-Short Equity. Most long-short equity hedge funds have an overall long bias. Due to their net long exposure, long-short equity hedge funds exhibit above average performance in upward trending markets, and normally experience a net loss in downward trending markets. If hedge fund managers can successfully select which securities they short and which securities they buy, this "alpha" should move the return distribution toward more positive skewness than equity benchmarks. Some managers engage in so-called "double alpha" strategies, investing in companies they expect to increase in stock value and shorting companies they expect to decrease. This strategy is expected to exhibit positive skewness and excess kurtosis.

Multi-Strategy. Multi-strategy hedge fund managers follow a diversified investment approach. They seek to profit by allocating their capital among many different strategies and adjusting their allocations based on perceived opportunities. Multi-strategy hedge fund managers may also use systems trading strategies such as trend-following and various diversified technical strategies. This style allows managers to over or under-weight different strategies to best capitalize on current investment opportunities. This strategy is expected to exhibit consistency with a normal returns distribution.

ASSET ALLOCATION

Figure 3: The Investment Process



	Objectives	Strategic Asset Allocation	Tactical Asset Allocation	Product and / or Manager Selection	Performance Measurement and Evaluation
Role	• Define objectives; investment policy statement	• Define bands for tactical allocation	• Define specific, short-term allocation	• Choose managers	• Performance assessment
Horizon	• 7–10+ years	• 2–3 years	• 0–1 year	• 0–3 years	
Frequency	• Annual review	• Annual review	• Quarterly or market-driven	• Ongoing	• Ongoing
Inputs	• Return objective • Risk profile • Liquidity requirements • Portfolio constraints	• Long-term forecast – Returns – Risks – Correlations • Liquidity	• Short-term forecast – Returns – Risks – Correlations	• Consistent alpha • Covariance with asset class risk	• Actual returns and risks
Level	• SWF	• Asset class	• Asset class	• Product • Individual Manager	• Product • Individual Manager

Source: CCA

The Strategic Asset Allocation (SAA)[23] model meets the goals of the SWF over multiple market cycles – the long-term nature of SAA targets to create investment performance that will not be derailed by financial market cycles. SAA, at the overall SWF level is typically embodied in a benchmark portfolio, and is determined by the SWF's policy purpose, liability profile (if any), horizon over which expected returns and risk are defined, and characteristics of different asset classes. It may also specify constraints such as concentration risk with regard to individual holdings, liquidity, geographical and sectoral concentrations.

Tactical Asset Allocation (TAA), in contrast, is intended to take advantage of financial markets when opportunities appear to be out of line; as the investment environment shifts, allocations are changed to capitalize on opportunities. TAA is another source of active return designed to facilitate a fund's long-term goals by adding extra returns. TAA also looks to adding actively managed alternatives to passive benchmark risk, generating alpha drivers, which generate excess returns over a broad financial index. As a result, TAA is implemented to beat the market and to change the distribution of returns of the SAA.

Optimal SAA Strategy for a SWF:

- A performance-seeking portfolio that may be more heavily invested in return-enhancing assets including hedge funds
- An endowment-hedging portfolio that is customized to meet the risk exposure and needs of the country's endowment streams
- A liability-hedging portfolio tilted towards bonds for interest rate hedging motives, and in assets exhibiting attractive inflation-hedging properties

While the first building block is the standard highest risk-return component in any investor's portfolio, the other two building blocks need to be customized to meet the tailored needs of each specific SWF.

[23] Strategic Asset Allocation (SAA) sets investors' long-term exposure to systematic risk and caters to their risk and return objectives and constraints. Tactical Asset Allocation (TAA) involves short-term adjustments to asset weights based on short-term predictions of relative performance across different hedge fund strategies. TAA is an active and ongoing investment discipline, whereas SAA allocations are revisited only periodically, or when the investor's circumstances change. In this paper we assume that the SWF's investment policy statement allows for an outlay to hedge funds as part of SAA.

ASSET ALLOCATION WITHIN HEDGE FUNDS

We distinguish between SAA at the overall SWF level and asset allocation across various hedge fund strategies for the constituent hedge fund asset class. Asset allocation, within different hedge fund strategies is the focus of this section, and is the first stage in the investment process.

The time horizon in setting the asset allocation model for hedge fund strategies is typically two to three years. This is in contrast to the overall SAA for the SWF, which often may be as long as 10 years. The reason for selecting a shorter period is that, unlike traditional asset classes, specific hedge fund strategies do not exhibit stable long-term consistent return patterns. Arbitrage opportunities are fleeting as pricing anomalies do not last forever and investing themes may drastically change. This requires periodically (as often as once in two years) revisiting the asset allocation model for hedge fund strategies.

Asset allocation determines strategy selection, weights, desired style biases and often specifies a risk budget at the overall asset class level. It involves arriving at an initial portfolio allocation consistent with the investor's objectives and constraints. The process usually begins by formulating views on expected returns by strategy type, estimating historical and projected risks, and correlations. Projections involve combining historical data with economic theory or intuition.

Views. Hedge fund investing is about thinking of views as potential sources of alpha. In a portfolio construction context, views are much more than qualitative expression. Views need to be expressed as statements that some given combination of hedge fund strategies will have – a stated expected return, some expected volatility, some expected liquidity, some expected relationship with other assets – with some degree of confidence or uncertainty.

Thus, a view that a certain hedge fund strategy will outperform another, can be formulated as a set of weights combined with a statement that the strategy will have a particular expected return with a given degree of uncertainty. The weights reflect the different expected returns of the views as well as their uncertainty, as well as the expected correlations of the views and the covariance matrix of the underlying strategies. The unconstrained optimal portfolio is intuitive in that it is simply a tilt away from the market portfolio in the direction of a linear combination of view portfolios. A combination of theory, intuition, and backtesting can be used to select view portfolios that have positive expected return.

Problems in Asset Allocation

In practice, however, if the asset allocation to various hedge fund strategies that results from a standard portfolio optimization exercise is much different than expected, it is not uncommon to change the set of expected returns or introduce restrictions on the portfolio weights to arrive at a SAA that is “more realistic” and “acceptable”. In such situations a more systematic and structured way of thinking about SAA may be useful – but the practical implementation of this idea has certainly not been easy; asset allocation to hedge funds involves addressing data issues and optimization issues.

Data Issues. Not only do hedge funds exhibit nonlinear option-like exposures to standard asset classes – rendering traditional linear factor models quite inadequate in capturing their risk-return tradeoffs – they also have important data challenges. These data challenges include measuring and forecasting true risk, incorporating the effect of illiquidity, tradability restrictions, reporting bias and information asymmetry, serial correlation, strategy drift, unique risks and other issues posed by active management. We highlight these issues here as well as suggests possible solutions.

Optimization Issues. When it comes to asset allocation using mean-variance optimization, every hedge fund portfolio constructed is likely to be suboptimal. We later highlight the shortcomings of mean-variance optimization for hedge funds and suggest alternative approaches.

Data Issues

Source data biases complicate asset allocation and portfolio construction for hedge funds. Next, we consider some of these biases and build a framework to resolve them.

Illiquid Assets and Restrictions on Tradability. Some hedge fund strategies are relatively illiquid investments with "lockup" and "liquidity" provisions. Many specify a lockup period ranging from six months to five years. These restrictions affect the ability to rebalance, respond to new investment opportunities and meet unforeseen cash requirements. In exchange for these limitations, investors expect to receive a premium for locking up their assets. Therefore, it is important to account for these restrictions by incorporating an illiquidity and a tradability premium into the risk-return tradeoff framework.

Reporting Biases. Since industry returns are usually reported for a sample of funds, the performances of many funds – often (but not exclusively) those funds that perform poorly – do not appear in published indices. This reporting bias has the potential to artificially inflate reported performance.

Serial Correlation. As is the case with highly illiquid assets, such as real estate and private equity, certain hedge fund strategies are characterized by pricing distortions in reported returns. This can lead to an understatement of risk. When corrected for serial correlation, some hedge fund risks may be higher than believed.

Strategy Drifts. Fund managers may change their investment focus over time to seek higher returns. This introduces potential risks that an investor might not have known it was taking.

Tail Risk. Some hedge fund investment strategies are peculiarly subject to extreme event risks. For SWFs, which are particularly concerned about limiting losses, this means that traditional measures of risk, such as volatility, might be inappropriate. Therefore, an asset allocation framework that explicitly accounts for downside or tail risk is important.

Only by accounting for these issues, amongst others, can SWFs build portfolios that systematically include hedge funds in their overall portfolios. Approaches to resolving these biases are discussed next.

Illiquid Assets and Restrictions on Tradability

Hedge funds differ widely in the liquidity that they offer investors.[24] Generally, fund investors may be subject to at least three types of liquidity and tradability constraints:

Lockup. A lockup is the period where the initial capital allocated to a fund cannot be withdrawn for a certain period of time. Lockup periods may range from three months to a few years.

Redemption Restrictions. After the lockup period, investors in hedge funds may redeem their capital. However, the redemption process is not continuous and investors may only redeem at certain points in time. The periods where investors are allowed to withdraw funds are determined by the redemption frequency. Redemption frequencies can range from monthly to annually.

Redemption Notice. Redemption notice is the amount of notice that investors must provide to a fund manager before being able to withdraw an investment from the fund. Redemption notice periods may range from 30 days to longer.

All else equal, the more restrictive each of these elements is, the "worse" it is for investors.[25] Investors prefer to obtain more favorable liquidity terms – in other words, to have the option to trade

[24] Strategies that invest in relatively illiquid securities, such as event-driven, fixed-income and convertible arbitrage, have longer restrictive periods than those that trade in exchange-traded securities such as managed futures and global macro.

[25] Illiquidity has differing implications for different SWFs. SWFs that actively manage their short-term portfolios and actively speculate through making tactical calls are drawn to use the liquidity features in an underlying investment. They may, for instance want to get out of their investment because they may want to limit their losses or reallocate. Then, there may be others who do not make tactical allocations but may have an unanticipated need for liquidity – who may be seen as "cash-seekers".

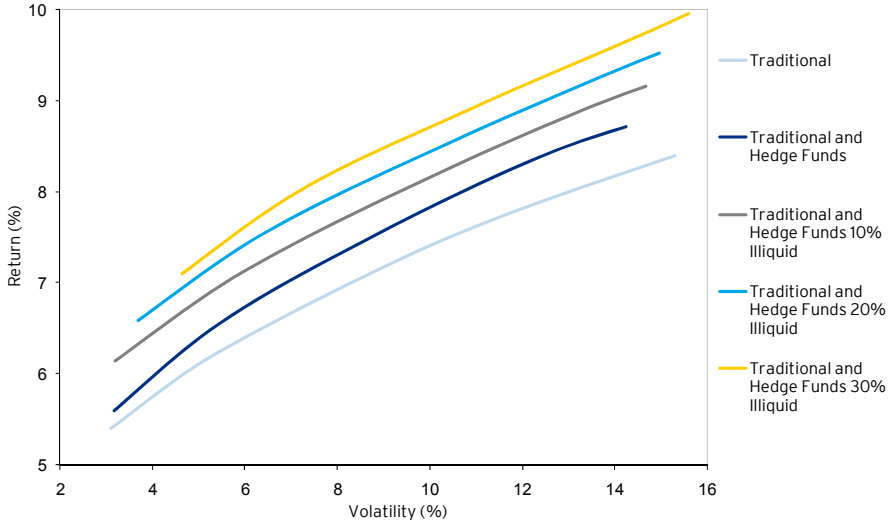
out of their investments if it came at no cost. These options give an investor more control over their investments to rebalance their portfolio as they wish or to respond to unforeseen cash flow requirements.

Tradability Premium. The first implication of constraints on tradability is that a portfolio can remain at an "inefficient" point for a longer period than if the assets were fully liquid. One can conceptualize these types of restrictions as a "cost" of investing in hedge funds: in practice, forcing portfolios away from efficient points is a cost in "utility" to the SWF. How might this cost be estimated? Conceptually, it is a function of two things: (i) time – how long one is away from the optimal point, and (ii) distance – how far one is away from the optimal point on the efficient frontier. The size of this cost will depend on the degree of illiquidity, risk aversion, cash flow and income characteristics of the portfolio.[26]

A second implication of the lack of tradability for certain strategies is that, even after accounting for mark-to-market risk and rebalancing restrictions, there should still be a remaining premium for locking up an investment. In other words, there is an implicit option value in being able to trade an asset, a value that is lost for those investing in illiquid assets. This excess is what may be thought to be the tradability premium.

Illiquidity Premium. For traditional exchange traded instruments, a proxy for liquidity is the magnitude of the bid-offer spread or other measures derived by simply observing trading volume. This method does not work for hedge funds as they are not exchange traded. Also, different hedge fund strategies invest in different underlyings, of which many are relatively illiquid. Since their underlying holdings are infrequently revalued, future movements in returns are often a function of lagged returns. This pattern is called auto correlation. The degree of auto correlation in a trading strategy may serve as a measure for illiquidity which can be translated into a premium for illiquidity.

Figure 4: Illiquidity Premium



Source: CCA, stylized illustration of illiquidity premium

Portfolios that explicitly account for this premium may be constructed in a three-dimensional framework, incorporating risk, return and liquidity.[27] In these terms, liquidity is filtered into discrete units based on the degree of non-tradability in the asset. Intuitively for a given level of risk, investors would expect returns to increase as liquidity decreases. This measure thus provides an explicit measure of the "illiquidity premium" at the hedge fund portfolio level.[28]

[26] The liquidity premium in the case of annuities is estimated between 45-145 basis points per annum as compensation for the inability to rebalance during a 10-year period in *The Liquidity Premium for Illiquid Annuities* by Browne, Milevsky, Salisbury (2002).

[27] This approach has been explored in *It's 11pm - Do You Know Where Your Liquidity Is? The Mean-Variance Liquidity Frontier* Lo, Petrov and Wierzbicki (2003).

[28] We estimate this premium to generate roughly 30–50 bps of return for every 10% increase in illiquidity in the portfolio in excess of the risk premium.

Reporting Biases

Selection Bias. Selection bias occurs when, for example, a hedge fund operator waits until the fund's performance is acceptable before allowing it to be collected in a database. Since hedge fund managers have no disclosure requirements and the inclusion of a fund is a voluntary manager decision, only funds with good performance may want to be included in a database. The performance calculated by databases thus tends to be overstated relative to the actual universe performance. However, these upward biases are potentially mitigated by managers who have performed well but do not want to publish their performance because they have reached their goal in terms of assets under management. The net effect of these reporting biases often cancels out.

Survivorship Bias. Survivorship bias occurs when a data collector removes particular investments from the database, and reports only the performance of the "survivors." The end result is usually an upward bias in the average returns of the remaining investments because the database no longer contains many of the worst investments. Not all hedge fund databases have equal amounts of survivorship bias, however. Therefore, as a first step, indices that are least prone to these biases should be selected.[29] Second, the best indices still contain residual biases. In order to estimate these biases, investors may develop proprietary models to estimate the size of these (generally upward) biases, which are then removed from the estimate of returns in hedge fund indices.

Instant History Bias. Instant history bias (or backfill bias) is the consequence of adding a hedge fund whose earlier returns are backfilled between the inception date of the fund and the date it enters the database.[30] This bias can be rectified by eliminating the fund's returns prior to inclusion in an index.

Short History Bias. Short history of data prevents the impact of varying market environments on hedge fund performance from being evaluated. Estimations of this bias range from 0% to 0.60% a year depending on the observation period, the sample and the constraint imposed on the length of the minimum track record.[31]

Serial Correlation and Smoothed Returns

Serial Correlation. Serial correlation is the degree to which each period's returns mirrors the results of the previous period. A fund that returns the exact same amount every month is perfectly serially correlated. In a perfectly efficient market, price changes must be perfectly unforecastable and there should be no serial correlation in returns. Yet, hedge fund returns, when examined, do display serial correlations in their returns.[32] The major reason for this bias is due to illiquidity and smoothed returns. When considering data issues, errors, on account of serial correlation, need to be statistically removed to re-estimate the "true" return distribution.[33]

Smoothed Returns. If true returns are independently distributed, and a manager fully reports gains but delays reporting losses, then reported returns will feature conditional serial correlation, a feature of returns smoothening. A hedge fund manager might smooth returns in order to lower the apparent risk of a fund, thereby increasing its risk adjusted performance and making the fund more attractive to potential investors. Formally, the smoothed return is a weighted function of the unsmoothed return and lagged return. SWF investors benefit from knowing whether a fund's returns have been artificially smoothed because they would then be able to execute more informed due diligence prior to the investment decision. Smoothed returns result in fund assets being either

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[29] G. Amin and H. Kat, (2001); Liang, (2000).

[30] Fung and Hsieh (2000) estimate this to be around 1.4% per year – data examined was from 1994 to 2001.

[31] Fung and Hsieh (2004).

[32] Average serial correlations vary considerably across categories, but five categories have high averages: fixed-income directional (21.6%), convertible fund – long-only (22.5%), event-driven (20.8%), non-directional / relative value (18.2%), and emerging market (18.8%). These categories include some of the most illiquid securities traded; serial correlation seems to be a reasonable proxy for illiquidity and smoothed returns. Moreover, the funds that invest in the most liquid securities – equities and futures – show the weakest average serial correlation: equity hedge funds give (7.8%), and managed futures (-0.1%). These concepts are further explored in Getmansky, Mila, Lo, Andrew W. and Makarov, Igor. An Econometric Model of Serial Correlation and Illiquidity in Hedge Fund Returns (2003).

[33] Getmasnky, Lo and Makarov (2003); DeSouza and Gokcan. *Hedge Fund Volatility: It's Not What You Think It Is*.

overvalued or undervalued. One of the main implications of smoothed returns is that Sharpe[34] ratios are biased upward, through a reduction in volatility.[35] Once again, when considering data errors on account of smoothing, the data needs to be unsmoothed statistically to re-estimate the "true" return distribution.

Strategy Drifts

The notion of strategy drift involves a manager's discretionary change in investment strategy. As opportunities eventually disappear in their original strategies, it is common practice for some hedge fund managers to start looking at other markets. Managers can and do change their strategy over time, which changes the statistical properties of the fund return.

How can investors then deal with this problem? If the strategies drifted in an unsystematic pattern, finding a solution would be elusive. However, if managers move systematically between subsets of strategies, then a more stable basis upon which to forecast and allocate might be possible. A cluster analysis – which is a technique that seeks to group strategies that are highly correlated and to distinguish them from groups of strategies that are less correlated is one way to reduce the effect of strategy drift. These groupings may be seen as:

- Event-driven plus (convertible arbitrage, merger arbitrage and distressed)
- Fixed-income arbitrage
- Equity arbitrage (statistical arbitrage and equity market-neutral)
- Discretionary (global macro and equity long-short)

Table 2: Hedge Fund Data Issues

Bias	Description	Implication
Illiquid Assets	• Underlying holdings are infrequently revalued	• Mark to market values are imprecisely measured • True risks and returns are misstated • Returns on account of illiquidity premium
Tradability Restrictions	• Three months to longer lockup terms • Redemption restrictions	• Portfolio allocations may remain at 'inefficient' points • Limits ability to rebalance and ability to respond to new opportunities • Returns on account of tradability premium
Reporting Biases	• Selection bias; selectively include only well performing funds in database indices • Survivorship bias ; failed funds or funds that close down are removed from database indices • Instant history bias; earlier returns are backfilled between fund inception date and date fund enters database • Short history bias; funds with short history do not reflect manager ability to navigate varying market environments	• May upward bias overall index returns unless offset by well performing managers who do not voluntarily report performance • Upward bias in overall index returns • Difficulties in comparing managers with different length of track record • Reduced confidence in manager history
Serial Correlation	• Current period's returns partially reflect previous periods performance on account of illiquid holdings	• Volatility appears to be less than actual and risk adjusted performance numbers are upwardly biased
Smoothed Returns	• Managers may report gains but delay reporting losses to lower the apparent risk of the fund	• Risk adjusted performance numbers are upwardly biased and fund appears more attractive to investors
Strategy Drift	• Managers may change strategy without investor consent and deviate from fund's mandate to pursue short term gains	• Investors not aware of true risks that they are taking at an aggregate portfolio and at the manager level
Unique Risks	• Volatility may not reflect true risks as credit, concentration, market and illiquidity risks interact in unexpected ways	• True risk is underestimated

Source: CCA

[34] A measure of the risk-adjusted portfolio performance. It is calculated by dividing the risk premium return (average portfolio return less average risk-free return) by risk (standard deviation of portfolio returns).

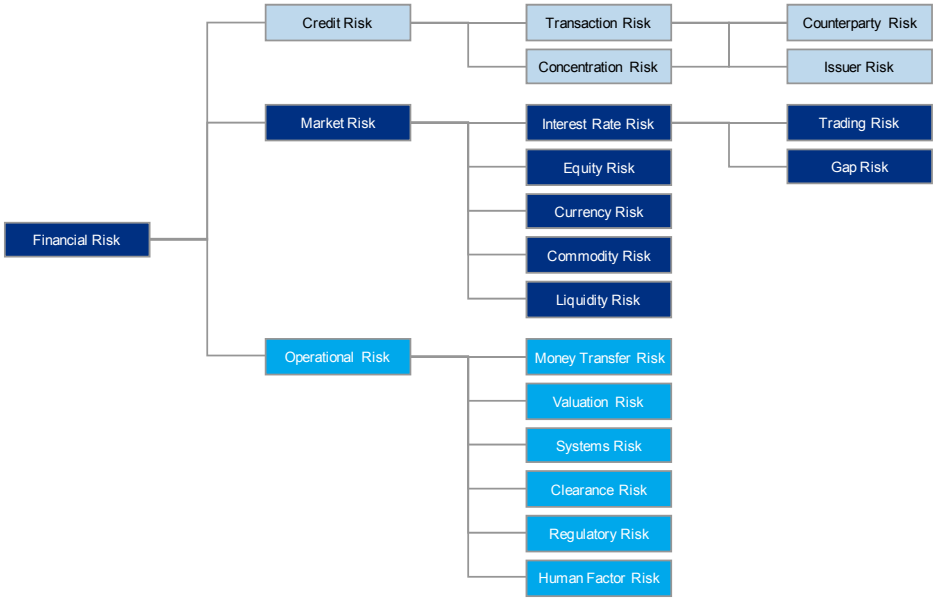
[35] We estimate that the largest differences between standard and smoothing-adjusted Sharpe ratios are in the categories identified as the most illiquid; fixed-income directional (standard Sharpe ratio is (20.3%) higher than the smoothing-adjusted Sharpe ratio), event-driven (16%), non-directional / relative value (16.3%), and emerging markets (17.8%). For dedicated-short and managed futures, the bias is reversed because of negative serial correlation in their returns. For the other categories, the bias is not significant. These results suggest that serial correlation is a proxy for illiquidity and smoothed returns.

Hedge Fund Risks

Volatility does not accurately reflect true risk in hedge funds. This is because their returns are not distributed symmetrically or "normally" around their mean. For this reason, the use of volatility to measure risk is often insufficient. Also, most investors are concerned about other form of downside risks in addition to volatility[36]. The typical volatility measure – "standard deviation"[37] – may drastically understate the downside risk inherent in many trading investment strategies.

Before delving into some risk measures we examine the risks themselves.

Figure 5: Partial List of Risks that Hedge Funds Manage



Source: AIMA

Credit Risks. Credit risks arise when a debtor counterparty is unable or unwilling to service an obligation which may result in losses. Credit risk takes many forms and the manner in which credit exposure is assessed is highly dependent on the nature of the obligation.

Concentration and Liquidity Risk. A hedge fund's portfolio of investments is subjected to concentration and liquidity risks when it is highly concentrated in a specific currency, industry, or security type. Concentrations in securities of a specific industry may expose fund investments to undiluted industry risks which could deviate significantly from general market trends.

Market Risks. Market risk specifically addresses price risk which often arises from changes in exogenous factors such as interest rates, prepayment and extensions in the case of mortgages, absence of liquidity, sectoral concentrations in portfolio, currency risk and derivatives risk.

Interest Rate Risk. Interest rates are a very important determinant of bond prices and represent one of the more important risk factors in fixed-income arbitrage strategies.

Prepayment and Extension Risk. Certain instruments, such as mortgage-backed securities are price sensitive to interest rate movements for they may be prepaid earlier or later than expected, depending on where interest rates stand. This, in turn, potentially changes the duration of securities that hedge funds hold and leads to changes in risks within their trading strategies.

Currency Risk. When a fund holds securities in a currency other than in its base currency, changes in the exchange rate between its base currency and the currency of its holdings may

[36] These will be described subsequently

[37] A measure of the variation of returns around the mean return. Standard deviation is the most widely used approximation of the risk of an individual investment or portfolio; also referred to as volatility.

enhance or reduce its profits. The greater its exposure is to exchange rate movements, the greater its risk of price fluctuations.

Derivatives Risk. Derivatives risk is a broad term that comes from the usage of derivative products such as futures, options, swaps, floating rate notes, structured notes, etc. Utilization of derivative products for speculative purposes can substantially change a fund's risk profile.

Table 3: Partial List of Risks in Hedge Fund Strategies

Hedge Fund Category	Typical Risk Exposures by Strategy
1. Relative Value	1. Convertible Arbitrage: Interest rate risk, credit risk, equity volatility risk 2. Fixed-income Arbitrage: Interest rate risk, credit risk, model risk 3. Equity Market-neutral: Individual equity risk, model risk
2. Event Driven	1. Merger Arbitrage: Deal risk / corporate event risk, equity volatility risk 2. Distressed / High-yield Securities: Corporate event risk, credit risk, equity volatility risk, interest rate risk, liquidity risk
3. Opportunistic	1. Equity Hedge: Equity market risk, equity volatility risk 2. Global Macro: Equity market risk, interest rate risk, currency risk, credit risk 3. Managed Futures: Commodity market risk, interest rate risk, currency risk, model risk 4. Emerging Markets: Equity market risk, interest rate risk, political risk, credit risk, currency risk, liquidity risk

Source: AIMA

Metrics for Measuring Hedge Fund Risks

Practitioners use "downside risk" to express either the likelihood of a loss, or the magnitude of a loss or some measure of the dispersion of losses that may arise from investing in hedge funds. Several risk adjusted performance ratios that incorporate downside risk have been developed over the last few years. Commonalities in the way to measure and interpret downside risk enable classification of different downside metrics into at least four groups:

Probability of Loss Metrics. This class of downside risk metrics tries to capture the likelihood of a loss, without any consideration with regards to the size of the loss. In this category, we find the shortfall probability, which is the probability of a return outcome under a minimum acceptable return (MAR).

Magnitude of Loss Metrics. These metrics capture the magnitude of losses. They include:

Value at Risk (VaR)[38]: This measures the minimum loss one would incur within a probability confidence which is generally set from 95% to 99% over a time interval .

Modified Value at Risk (MVaR). If VaR is calculated, as it often is using skewness and kurtosis of a distribution, it is known as MVaR. The MVaR has the property to adjust the risk, measured by volatility alone, with the skewness and the kurtosis of the distribution of returns. The MVaR is often used to solve for optimal portfolio allocation by minimizing the MVaR at a given confidence level. This is a useful measure since hedge fund returns often have negative skewness or positive excess kurtosis.

Conditional Value at Risk (CVaR): CVaR explicitly accounts for the negative tail risk and can be applied to construct portfolios involving hedge funds. CVaR focuses on both frequency and size of losses in case of extreme events and, to that extent, is a more robust measure. In other words it measures the average loss if the VaR level is breached – the CVaR is always equal to or greater than the VaR

[38] A critical decision in selecting a VaR model for hedge funds is the distributional assumption. However, in contrast with traditional assets for which the normal distribution presents the best performance, the t-student and, especially the Cornish-Fisher expansion, distributional assumptions tend to have the best performance.

Maximum Drawdown: The maximum drawdown is the maximum loss one can endure if one had invested at the fund's maximum net asset value and sold at the minimum fund net asset value subsequent to the initial investment.

Tail Risk Metrics. This class of downside risk metrics capture the dispersion in returns below a threshold or MAR. Within this class of metrics, exist lower partial moments (LPM). The LPM is defined by a MAR level and an order or exponent. A LPM of order 2 is analogous to the variance calculated for the distribution of returns below MAR. Extending the same logic, LPMs of order 3 and 4 are akin to skewness and kurtosis of returns outcomes below the MAR. Hence, the LPM is able to better capture the behavior of the distribution of losses, without penalizing gains above the minimum.

Downside Risk Performance Ratio Metrics. Investors are not only interested in the amount of risk they have, or how much they may stand to lose, but also in whether they are adequately compensated for bearing it. This interest led to the development of risk adjusted performance ratios, of which the Sharpe ratio has become the standard in the investment industry. However, the Sharpe ratio is a function of the volatility and thus suffers from the same weaknesses as the volatility itself when applied to non-normal distributions of hedge fund returns. Nevertheless, the intuition behind the Sharpe ratio can be translated to deal with risk metrics that focus on the downside. In such downside performance ratios, the numerator measures the potential upside and the denominator measures the potential loss. Several of these ratios exist, of which, the Calmar ratio, the modified Sharpe ratio, the Sortino ratio, the Omega function and the generalized family of Kappa ratios (of which Omega and the Sortino ratio are special cases) are more popular.

Section Summary. The preceding section drew attention to the limitations of historical hedge fund returns data and suggested ways to improve and correctly interpret time series information. Having corrected for data and reporting bias, and rationalizing for illiquidity and tradability restrictions, as well as devising proper measures to capture the unique risks in hedge fund strategies, investors can develop robust asset allocation models. This is considered in the next section on optimization issues.

Optimization Issues

To form a long-term portfolio, investors must first think systematically about their preferences and about the constraints that they face. Second, they must form beliefs about the future – about expected returns, risks, correlations and the variance covariance matrix. Third, investors must solve the intertemporal optimization problem – the multi-period portfolio selection problem formulated as a Markowitz mean-variance optimization problem (or a variant as subsequently demonstrated in this paper) – in terms of time varying means, covariance order and intertemporal movements of asset prices.

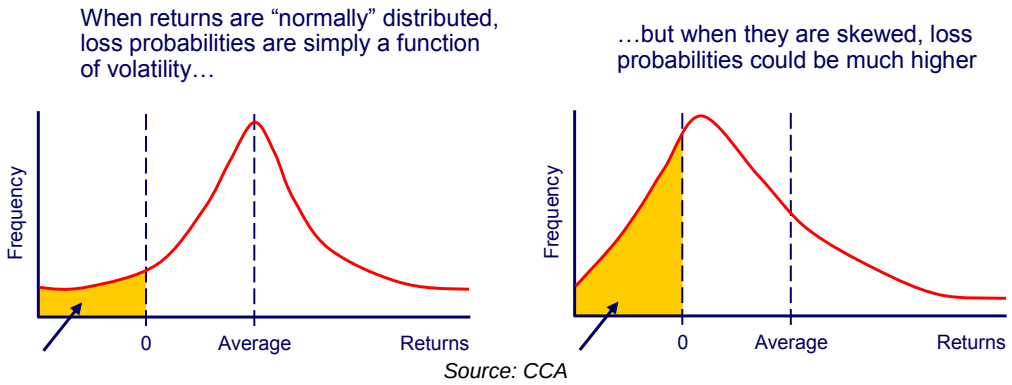
Problems with Mean-Variance Optimization

Markowitz's Mean-Variance Optimization Does Not Work for Hedge Funds. Markowitz's classic mean-variance approach is widely used for asset allocation for traditional assets and many asset allocation tools and models have been built around this framework, all of them predicated on a set of implicit assumptions. At least three conditions must be met to use Markowitz's mean-variance framework efficiently:

- The historical returns distribution needs to be symmetric
- The investor's utility function needs to be quadratic
- The mean and the variance are sufficient to completely determine the returns distribution

Markowitz's mean-variance method assumes that returns in each asset class can be accurately measured. On the basis of these observations, one can appropriately characterize the risk inherent in each asset class. Similarly, it relies on the assumption that the asset returns are comparable; for example, that the liquidity in each asset class is roughly comparable. Finally, it assumes that risk is appropriately characterized by volatility.

Figure 6: Volatility Does Not Accurately Reflect Risks



Source: CCA

Markowitz's Assumptions Violated. Hedge fund return characteristics fundamentally challenge these assumptions. In hedge funds, it is very difficult to accurately assess returns on a basis comparable with returns of traditional asset classes. Unlike traditional investments, in which prices are observable on a continuous basis, it is not possible to observe market prices for many hedge fund strategies. This makes it difficult to estimate mark-to-market returns and makes the measurement of risk and, most importantly, the comparison between various investment risks, extremely difficult. Similarly, the fact that alternative investments usually contain significant restrictions on tradability, unlike their traditional counterparts, implies additional constraints to investors that cannot be accounted for in the standard mean-variance framework. Furthermore, unlike traditional investments, alternatives rely on the notion of restricted markets that exploit inefficiencies. Finally, in many alternative investments, the returns are not well approximated by the assumption that returns are distributed according to a normal, bell-shaped distribution. Thus, the use of volatility as a way of measuring risk may leave investors with potentially unaccounted-for downside risk. Also, forecasting volatility using a normal distribution assumption may be erroneous.[39]

Table 4: Mean-Variance Optimization Does Not Work for Hedge Fund Asset Allocation

Classical Assumptions	Actual for Alternative Investments
• Data accurately measures returns	• Inconsistent measurement of returns
• Risk is appropriately measured	• Risk not captured by data
• Asset returns are comparable – Marked-to-market valuations – All assets are fully liquid	• Asset returns are not comparable – Mixture of stale and current valuations – Variable degrees of liquidity
• Efficient markets are open to common set of investors	• Inefficient markets are not open to all investors
• Volatility is an appropriate measure of risk	• Volatility may not be appropriate measure of risk
• Data measured over same time periods	• Data measured over different time periods

Source: CCA

Historically, hedge fund returns often exhibit asymmetry and excess kurtosis, but they may also exhibit autocorrelation (as we saw earlier hedge funds tend to have significant exposure to lagged market returns), as well as time varying conditional variances and covariance and correlations.

It is important to allow for nonlinear risk-return relationships while analyzing hedge funds or when incorporating them into portfolios. They tend to exhibit non-normal payoffs for a variety of reasons; such as their use of options, or option-like dynamic trading strategies or strategies that may lose excessive money during market downturns. Since the mean-variance framework implicitly assumes a normal distribution of asset returns, it is likely to underestimate extreme risk (also known as the

[39] The exponentially weighted sample variance and E-GARCH models have the best volatility forecast performance for hedge funds in terms of statistical loss functions. In contrast, for traditional assets, the best volatility model is the sample variance.

tail risk) for assets with negatively skewed payoffs i.e., the expected tail losses of mean-variance optimal portfolios can be significantly underestimated compared to say a mean-CVaR optimal portfolio. Therefore, ignoring rare extreme risks of hedge funds can result in significantly higher losses during large market downturns.

Simple mean-variance optimization only requires the expected return vector and expected covariance matrix of the returns as inputs. Factors such as each SWF's particular circumstances, and investment and risk preference, become irrelevant. The mean-variance model is based on a formal quantitative objective that will always give the same solution with the same set of parameters. Thus, the formulation can be solved efficiently either in closed form or through numerical methods – hence its widespread adoption.

Many of the underlying assumptions of mean-variance portfolio optimization are open to question. For example, utility might involve preferences for more than mean and variance and might be a complex function, in which a quadratic approximation is not appropriate. Financial asset returns are skewed and may have fat tails. When asset returns are skewed, it is also arguable whether variance is the correct risk measure since it equally penalizes desirable upside and undesirable downside deviations from the mean; to address this shortcoming, two alternative measures of risk – semi variance and shortfall risk – are sometimes used.

Also, the one-period nature of static optimization does not take dynamic factors into account, so some researchers argue for more complicated models based on stochastic process and dynamic programs.[40]

However, the most serious problem of the mean-variance efficient frontier is probably the method's instability. The mean-variance frontier is very sensitive to the inputs, and these inputs are subject to random error in estimation of expected return and covariance. Small and statistically insignificant changes in these estimates can lead to a significant change in the composition of the efficient frontier. This may lead to frequent and mistaken rebalancing to stay on the elusive efficient frontier, incurring unnecessary transaction costs. The traditional Markowitz portfolio optimization estimates expected return and the covariance matrix from a historical return time series and treats them as true parameters for portfolio selection. This "certainty equivalence" view has long been criticized, because of the impact of parameter uncertainty on optimal portfolio selection. The naive mean-variance approach often leads to extreme portfolio weights (instead of a diversified portfolio as the method anticipates), and dramatic swings in weights when there is minor change to expected returns or the covariance matrix. As a result, the practical application of mean-variance optimization is seriously hindered by estimation error. Small estimation error, of either input, usually leads to a portfolio far from the true optimal efficient frontier. Therefore, correct estimation of expected returns and covariance matrix is a crucial step in hedge fund investing.

In the investment management community, arguments are sometimes made in favor of focusing on estimating expected returns alone, since many believe that portfolio weights are more sensitive to changes in expected returns, than changes in the covariance matrix. Nevertheless, our own recent research increasingly shows the importance of reducing covariance matrix estimation errors as well. Furthermore, hedge fund return time series usually exhibit characteristics, such as volatility clustering (in which large changes tend to follow large changes, and small changes tend to follow small changes). The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model is arguably the most popular method to estimate these conditional variances. The GARCH model not only addresses the changes of variance and covariance over time, but also accounts for fat tails, volatility clustering and leverage effects. Accordingly, this may be used for arriving at hedge fund strategy allocation optimizations.

New Asset Allocation Models

Over the past 10 years, a large body of literature has focused on modeling hedge funds returns. These modeled returns translate into forecasts of expected returns, risk and correlation expectations for each strategy – all which serve as inputs for developing hedge fund asset allocation models. The initial approaches to modeling hedge funds returns used non-parametric linear factor models. These were augmented with option-like factors, as fund strategies were found to exhibit nonlinear risk-return characteristics, and non-normal option-like payoffs. Refinements and

[40] In the dynamic approach to asset allocation, actual returns and liabilities in one period directly affect the optimal decision for the following period. (e.g., if mean reversion exists in stock returns, then stocks are less risky if the investment horizon is long, and optimal allocation to stocks should be higher). The static approach does not consider links across time periods, and is less costly and complex to model and implement.

extensions included a state-space modeling approach, where nonlinearity is captured by factor loadings that are state dependent. More recently Markov regime-switching models have found favor for they better capture fat tails, asymmetries, autocorrelation, volatility clustering or mean reversion in time series. Academics and practitioners have collaborated to create four broad approaches that are at various stages of development and proprietary implementation. These being:

i. Extensions of the mean-variance framework, which substitute variance with measures such as VaR and conditional VaR, semivariance, absolute deviation, semideviation or absolute downside risk.

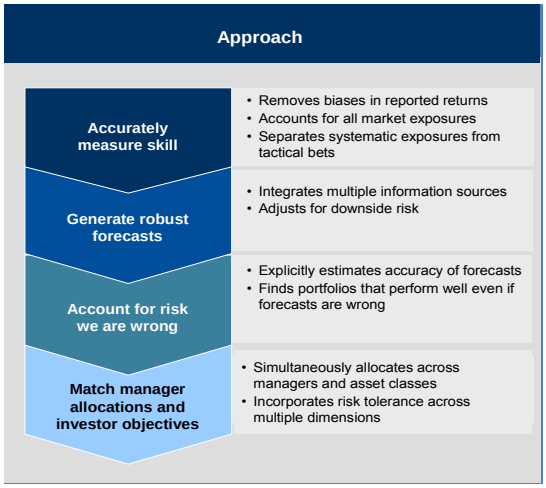
ii. Taylor series expansion models, which are used to derive a better approximation of expected utility and the investor objective function. These include using the Cornish-Fisher VaR method to directly embed skewness and kurtosis in the optimization process.

iii. Models that embed simulation techniques along with newer measures (conditional VaR, conditional drawdown-at-risk, mean-absolute deviation, and maximum loss as risk measures) that incorporate the statistical properties of the return distribution more adequately.

iv. Models that consider higher moments return distributions which optimize across mean-variance-skewness-kurtosis.

Any of these approaches can be used as an underlying engine for constructing a model for hedge fund strategy allocation. They all have their pros and cons, an examination of which is outside the scope of this paper. To illustrate these concepts better we now present a theoretical approach to asset allocation, portfolio construction as well as an implementation of an extension to the mean-variance framework. This approach allows for combining multiple alpha sources along with estimating and managing betas and manager exposures on an ongoing basis.

Figure 7: Asset Allocation Approach



Source: CCA

Unsmoothing. The first stage "unsmooths" the reported returns.

Factor Specification. The second stage determines the market factors that best explain each strategy's return on a historical basis.

Beta Estimation. The third stage uses a filtering method that estimates each strategy's level of exposure to the relevant factors on a time-varying basis. This information is used both, to determine the allocations, and to implement hedges (to beta), if required.

Portfolio Construction. The portfolio construction stage determines allocations by running an optimization process to identify the portfolio with the highest information ratio (i.e., highest alpha per unit of risk) on a projected basis. In addition, when determining allocations, this stage accounts for the downside and forecast risk of each strategy.

These stages may be codified in a model as four discrete modules that may be run at different frequencies, depending on the application. For example, the Unsmoothing module and Beta Estimation module can be run in conjunction on a weekly basis, since these are required to update beta hedges. Updating allocations will involve running the Unsmoothing module, Beta Estimation module, and Portfolio Construction module. The allocations may be updated quarterly, although they may be updated more frequently if the underlying set of strategies changes. Finally, the Factor Specification module may be run when new hedge fund strategies are being considered, or if there is a material change in the underlying market exposures of the existing strategies.

While the outputs of such a model would generate beta estimates and allocations between strategies, it is important to provide (to the portfolio manager) the flexibility to override the model's recommendations. This typically occurs if there is a significant change in one of the underlying strategies that the model does not adequately capture. In addition, the model itself requires qualitative inputs as well. For example, in order to specify the factors for each strategy, both the output of the Factor Specification module, as well as more qualitative information garnered through discussions with the managers may be used. The remainder of this section focuses exclusively on the model itself, and not on the broader portfolio management process.

Unsmoothing Module

In order to correct for smoothing in hedge fund returns, a simple model may be created that relates the true, but unobserved returns, to the observed returns. This model can be expressed as:

$$R_t^S = (1 - \sum_{i=1}^{p} w_i) R_t^U + \sum_{i=1}^{p} w_i R_{t-i}^S \quad (1)$$

Where,

R_t^S = Observed Smoothed price at time t

R_t^U = Unobserved Unsmoothed price at time t

w_i = Weight applied to lag *i* observed price

p = number of lags

The w_i coefficients may be derived by regressing R_t^S against an appropriate number of lags (the appropriate number of lags is chosen using the Akaike information criterion)[41]. Once the regression is completed, an unsmoothed time series can be derived using the following equation:

$$R_t^U = \frac{R_t^S - \sum_{i=1}^{p} \phi_i R_{t-i}^S}{(1 - \sum_{i=1}^{p} \phi_i)} \quad (2)$$

This derived time series for the unsmoothed returns forms the basis for all subsequent analysis.

Factor Specification Module

The factor specification module starts with approximately 100 equity, fixed-income, and commodity factors which may be downloaded from popular data sources such as Bloomberg. Examples of these factors include S&P 500, Russell 2000, MSCI, Goldman Sachs Commodity Index, etc. In order to determine the appropriate factors for each strategy, a stepwise regression of the unsmoothed strategy returns (excess of cash) may be run against the entire factor set (also excess of cash). For better results the stepwise regression may include factors whose p-values are below 0.05, and drop factors whose p-values increase beyond 0.1. This stepwise regression ultimately provides the subset of factors for each strategy that best explain that strategy's returns on a historical basis.

Beta Estimation Module

The beta estimation module is used to determine the level of each strategy's beta exposures on a time varying basis. Unfortunately, standard statistical techniques such as OLS[42] only estimate the "average" levels of beta exposure, and do not account for changes in beta over time. It is important to understand how these exposures change over time. In order to address this issue, an engineering technique, "Kalman Filtering", may be used to estimate the betas of each strategy on a time varying basis. Kalman Filtering treats the betas as latent variables that follow a process of

[41] Akaike, Hirotugu (1974). *A new look at the statistical model identification*. IEEE Transactions on Automatic Control.

[42] Ordinary Least Squares a method used in regression analysis for linear factor models.

their own. In a Kalman Filtering context, each strategy's returns (in excess of cash) can be expressed using the following two equations:

Observation Equation

$$R_t = \alpha + \beta_t X_t + \varepsilon_t \quad (3)$$

Where, $\varepsilon_t \sim N(0, R)$

Process Equation

$$\beta_t = M\beta_{t-1} + \omega_t \quad (4)$$

Where, $\omega_t \sim N(0, Q)$

Estimates for β_t are derived using the following equation:

$$\hat{B}_{t|t} = \hat{B}_{t|t-1} + K_t(R_t - \hat{R}_{t|t-1}) \quad (5)$$

Where, $\hat{\beta}_{t|t}$ is the estimate of the manager's time t market exposures at time t, $\hat{\beta}_{t|t-1}$ is the estimate of the manager's time t market exposures at time t – 1, R_t is the manager's actual return at time t, $\hat{R}_{t|t-1}$ is the manager's time t predicted return at time t – 1, and K_t is the Kalman Gain. Parameters Q and R may be solved using a maximum likelihood estimation procedure.

Portfolio Construction Module

The portfolio construction module determines allocations across various strategies using any popular optimization process. The objective of the optimization is to find the portfolio that provides the highest information ratio while accounting for the downside risk of each strategy, and the uncertainty in alpha and beta estimates.

The inputs into the optimization engine may include the following variables:

i. Projected alpha and alpha volatility for each strategy

ii. Beta exposures for each strategy

iii. Uncertainty in alpha forecasts, alpha volatility estimates and beta estimates

iv. Downside risk characteristics of each strategy's alpha

v. Correlations across the strategies' alphas

vi. Covariance matrix for the underlying market exposures to be hedged

vii. Cost of hedging each market exposure and cost of leverage

viii. Management and incentive fees

ix. Constraints (if any)

These inputs may be computed as follows:

Projected alpha and alpha volatility, beta exposures, and uncertainty estimates

Some hedge fund managers may have relatively short track records and their historical alpha may not represent their alpha going forward. At the same time, their historical alpha does provide some information regarding their abilities. In order to better forecast returns, an approach that combines historical performance with other information, known as a "prior", using a Bayesian forecasting technique, is often useful. The prior captures views of the manager "before" looking at the historical data. In other words, if one did not have access to the historical data, one would use the prior as a best estimate of the manager's future performance.

The prior may be expressed in terms of an information ratio, and computed using the following relationship:

*Prior IR = 0.14 – 0.39*ln (Annual Alpha Volatility)* (6)

This relationship was developed by examining the historical characteristics of several thousand hedge fund managers, from 1990 through 2008.[43] The information ratios of this set of managers conformed to equation (6) on average. The forecasting procedure is this approach, therefore, starts with the assumption that a strategy will perform as well as the average hedge fund manager, on a historical basis (since the prior represents the average performance of a large number of hedge fund mangers historically).

In order to implement this forecasting process, the next step is to first estimate the manager's alpha volatility on a historical basis, and use this to compute the prior information ratio according to (6). The prior information ratio can be then converted into a prior alpha using the following relationships:

*Prior Alpha = Prior IR * Annual Alpha Volatility* (7)

In order to combine the prior with the historical data it is best to incorporate the prior directly into the Kalman Filtering estimation. The prior alpha is treated as the initial alpha estimate, and a three year weight may be attached to this estimate.[44] In practice, this means that if a manager has a six year track record, the forecast would weight the historical data (approximately) twice as much as the prior. This procedure tends to generate much more accurate forecasts than using the historical data alone.

The Kalman Filtering approach provides four outputs that are used in the optimization:

i. Forecast alpha and alpha volatility

ii. Current levels of beta exposure

iii. Uncertainty in alpha forecast, alpha volatility forecast, and beta estimates

iv. Historical time series of alpha

Downside risk characteristics

The portfolio optimization penalizes managers for downside risk relative to upside potential. In order to impose this penalty, it is important to first quantify the downside risk of each manager's alpha, using a statistic known as Kappa. Kappa measures the manager's upside potential relative to downside risk at a certain threshold. Using the historical alpha time series produced by the Kalman Filtering technique, Kappa of each manager may be computed at the 20^{th} percentile of alpha returns. A projected Kappa can be generated by blending the historical Kappa with the average Kappa for a given strategy, again using a three year weighting on the strategy Kappa. The projected Kappa can be standardized using the following:

Kappa Standardized = (Projected Kappa / Kappa Normal Distribution)$^{1/4}$ (8)

Once this is done Standardized Kappas can be normalized to one across the set of managers. Finally, in the optimization, each manager's projected alpha needs to be multiplied by their Standardized Kappa. Since managers with greater downside risk will have a Standardized Kappa of less than one, this technique penalizes managers who have relatively more downside risk.

Correlations across alphas

Historical time series of alphas from the Kalman Filtering technique may be used to compute alpha correlations across managers. These correlations are computed on a pair wise basis. In order to reduce the estimation error in these correlations, managers may be grouped by strategy and correlations across strategy groups may be assumed to be zero.[45]

[43] Variants to this relationship may also be developed, should one decide to choose a different historical time frame.

[44] Any other period may also be chosen; the choice of period is a function of secular shifts in economic regimes.

[45] Refinements in the model may include allowance for correlations.

Covariance across market factors

Covariance across market factors can be calculated using five years (or more) of monthly data. Historical returns for each market factor can be obtained from popular data sources such as Bloomberg.

As alluded to earlier, the optimization tries to maximize the portfolio's information ratio after fees and hedging costs, but also accounts for the uncertainty in the alpha projections, alpha volatility projections, and beta estimates. This presents a challenge; most optimization approaches assume that the forecasts are correct, and are not equipped to deal with the risk that the forecasts are wrong. However, reflecting this risk is critical for two reasons:

i. Forecast risk can be significant in estimating a large number of parameters, and in some cases, parameters that have limited data

ii. Forecast risk varies substantially across managers. For example, managers with longer track records have less forecast risk than managers with shorter track records. This difference should be reflected in the allocations

In order to address this challenge, optimization processes that account for forecast risk need to be designed. For example, the optimization process may start by simulating 20,000 values of alpha, alpha volatility, and beta exposures for each underlying strategy. These 20,000 simulations represent the range of alpha, alpha volatility, and beta exposures that may exist across the set of managers, given the uncertainty in their parameters. After simulating these values, the optimization process may evaluate each portfolio, based on how it performs in the worst 5% (i.e., 1,000) of outcomes. The optimization process may be designed to choose the portfolio that produces the best average information ratio across the worst 1,000 scenarios (in other words, the portfolio with the best "worst-case" performance). The advantage of this approach is that it reduces allocations to managers who have not demonstrated an ability to generate alpha over long periods of time, and to managers whose betas are difficult to estimate.

Finally, any constraints on portfolio allocations or minimum return targets can be incorporated directly into the optimization process.

Extending the Mean-Variance Framework within a Risk Budget

A robust process of incorporating different hedge fund strategies in SWF portfolios involves making conscious choices around the amount of existing active risk in the portfolio, the optimal active risk budget, and quantifying risk budget changes as a function of both underlying strategies and manager selection capability. Therefore, a relevant framework for investors to use in making hedge fund allocation decisions is a risk based approach or the risk budget. An investment process predicated on discipline and risk control is crucial for successful portfolio construction, and SWF portfolios do control for risk and adhere to a risk budget. In such a framework the hedge fund strategy inclusion decision depends on both:

i. The expected excess return

ii. The marginal impact on portfolio risk

Efficient allocations require this ratio to be the same at every margin. The marginal contribution to risk of each hedge fund strategy depends on the covariance of that strategy with every other asset and every other hedge fund strategy as well as the amounts invested in each asset and in each strategy (in other words the "weight"). Thus if a portfolio is optimal, the implied expected excess returns must be proportional to the marginal contribution to portfolio risk.

This section illustrates the asset allocation process across hedge fund strategies by using an extension of the mean-variance framework, but utilizing different measures than volatility for risk.

Considerations.

i. A common asset allocation model may be used for both SAA and TAA for consistency

ii. The process needs to account for non-normal return distributional characteristics of hedge funds

iii. Constraints are based on supply of appropriate assets by strategy type, avoidance of concentration and liquidity requirements. In the case of the latter, liquidity requirements and structure will be determined based on market factors, and the degree of liquidity required may be used as a constraint for modeling purposes

iv. SAA return assumptions for different strategies often utilize predictions based on average spreads to underlying factors, meaning that those spreads must be stable over the strategic planning horizon. TAA return assumptions are often based on factor models to predict time varying return levels

v. Proprietary adjustments for serial correlation, stale valuations, and rebalancing costs may be employed to remove data bias

vi. The SAA process defines a set of asset weight bands which will be followed in TAA

vii. The TAA process results in the choice of specific asset weights for the following six to nine months

Framework. The basic framework for asset allocation within different hedge fund strategies is about maximizing the expected return subject to (i) a given risk level as measured by a risk parameter, (ii) taking only long positions, (iii) making full allocations, and (iv) other constraints given by either data, supply, or practical constraints.

Parameter Choice. The choice of the parameter accounting for risk may result from options available by extending the mean-variance framework. In the traditional Markowitz framework, the choice of the parameter is the volatility or standard deviation of the return distribution. This choice is suitable if either investors are risk neutral or if returns are normally distributed. In reality, however, SWF investors are risk averse. Also hedge fund returns are generally single-peaked (in other words have a single maximum), and tend to display both skew and fat tails.

The combination of these features suggests a different choice of parameter for the optimization problem. Standard deviation, accordingly, may be replaced by other parameters that measure risk. These may be percentiles of the distribution, VaR and conditional VaR, semi variance, absolute deviation, semi deviation, absolute downside risk or drawdown. The choice of the appropriate measure will depend on the nature of the SWF investors degree of risk aversion, as spelled out in the investment policy statement.

Algorithm Choice. Once the risk parameter is selected, the next step is to develop an algorithm for implementing that measure of risk. If the allocations are set across a small number of hedge fund strategies (e.g., less than five), an optimization algorithm model may be implemented using a search at given increments of weights. If the set of strategies is large, optimization algorithms that will solve for the optimal weights via an intelligent, directed search algorithm may be used.

Constraints. The choice of constraints is based on three factors. First, a set of constraints based on either, availability, or supply for each hedge fund strategy. For example, if a fixed-income arbitrage strategy manager does not exist at the time of investment, then the weight for that asset class can be constrained to be zero.

Second, a set of concentration constraints. These concentration constraints will restrict over-allocation to particular strategies. The determination of these concentration limits will be based on a combination of the risk budget plus or minus a certain percentage, and the assessment of the certainty that the data inputs are robust (with less data, or less confidence in the data, the risk budget constraints ought to be adjusted downwards).

Finally, liquidity constraints. Hedge fund strategies represent a mix of liquid strategies (e.g., global macro investing) and relatively illiquid strategies (e.g., distressed investing). The investment policy statement of the SWF often specifies liquidity requirements and the SAA process optimizes asset weights (allocated to different strategies), subject to a global liquidity requirement. The choice of weights within each broad class of liquidity generally affects the choice of weights in the other broad class. Therefore, the optimization process is a joint optimization process. In other words,

liquidity requirements will be a constraint on a joint problem, with liquids and illiquids, rather than a separate optimization of each.

Data Inputs. An important consideration in the SAA process is the choice of appropriate strategies and their expected return distributions. In general, the choice of fund strategies for inclusion will depend on three criterion:

(i) Diversification. First, the degree of diversification one can achieve within each of these strategies. From a modeling and optimization point of view, SWFs need investment choices that remain both statistically stable and distinct over long horizons. Statistical stability means that over long horizons investment choices have lower and more stable volatility, compared to un-pooled investments. Stability is important because in optimization for future periods, investors would want a portfolio that does not change dramatically on a period by period basis. Distinctness means that they have lower and more stable correlation amongst each other, compared to un-pooled investments.

(ii) Combination of Strategies and Managers. Second, the ability to combine different single hedge fund managers or better still combining different strategies into strategy groups to achieve targeted degrees of correlation. Over the long horizon that SWFs assume for SAA, there is a high chance that their future returns will become statistically different from their past returns. Statistical stability in return streams over long horizons can only be expected in pools of hedge fund managers that follow similar strategies, sometimes classified as "Strategy Groups".

(iii) Optimization Decisions. Third, a choice must be made about whether the asset allocation process will optimize the allocation within hedge funds exclusively, or if the asset allocation will optimize the fund assuming a particular set of weights in the overall SWF portfolio. If the optimization is between hedge funds and traditional assets, an additional set of inputs for traditional asset classes will also have to be employed.

Asset Class Adjustments. As described in the section on data issues, a number of proprietary adjustments have to be made to the historical distributions to improve the quality of the data inputs. In all of these cases, the effect of these adjustments is material on the asset allocation choices, and therefore makes the allocation much better than traditional models. For example, to correct for serial correlation, the historical distributions may need to be "unsmoothed".[46]

Rebalancing Costs. As described earlier, some relatively illiquid hedge fund strategies impose an implicit "cost" on portfolio optimization. In particular, since asset levels are nonreducible in illiquid asset classes, they constrain the ability to rebalance the assets dynamically. This means that as the life of investments unfold, illiquid assets can cause the realized asset weights to vary from the targeted ones. This imposes an implicit cost on the portfolio, which can be measured as the average distance from the efficient frontier. For this reason, asset allocation assumptions need to be adjusted for the illiquid classes in the form of a haircut to illiquid asset returns distributions. This haircut can be estimated through portfolio simulation, which will provide an estimate of the implied cost of illiquids at different weightings.

SAA bands. SAA bands are chosen to determine a framework for TAA to different hedge fund strategies. Here, the data inputs will be based on the average level of returns, risk and correlation in the specific asset classes. Notably in this case, if the return distributions are mean reverting, either in terms of their spread over a specific benchmark or absolute terms, then the average return characteristics will be used as inputs to the SAA process. The weights delivered by such a model will then constitute bands within which the TAA process must adhere. In practice the SAA data is updated once a year. At that time new strategic bands are established for use in the specific TAA.

The TAA Process

While the long-term SAA weightings rarely change, the tactical weightings to each sub-strategy can change significantly from quarter to quarter depending on assessments of opportunity for individual managers and the markets in which they invest. Tactical allocation determines the specific weights given to particular strategies. This is a periodic exercise – often undertaken every six months when

[46] First, based on inspection of the autocorrelation functions, an assessment of an appropriate horizon of lagged returns will be chosen. Second, an autoregressive regression will be estimated. For a first order process, this is: $R_t = \alpha + \rho R_{t-1} + \varepsilon$, the "unsmoothed" returns are estimated by: $R_t^U = \frac{R_t^S - \rho R_{t-1}^S}{1 - \rho}$, where S indicates smoothed and U indicates unsmoothed.

new TAA determinations are made. In such cases, changes with specified bands guide the asset weightings to different strategies for the next few months.

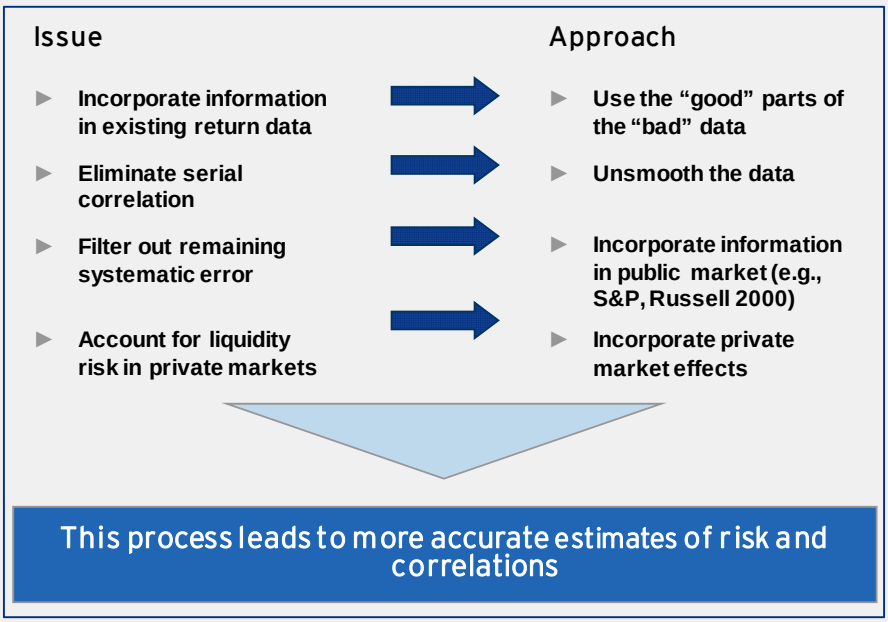
Data Inputs. Rather than predicting average return characteristics, the intention of TAA is to predict time variant return characteristics. Here the basis for the estimated returns are factor models for each specific hedge fund strategy. Finally, based on investment team judgment, these return distributions might be altered to reflect “new” regimes for particular strategies. This plays an important role if the forecasted factors are far outside the sample range for the empirically derived forecasting factor model. An example would be a case in which the interest rate environment is one which has never been observed over the life of the data.

Choice of Weights. Based on these data inputs, the asset allocation model will be utilized to determine specific weights. In this case, the SAA weight bands are imposed as constraints on TAA.

Special Considerations for Private Equity and Private Real Estate

In the real world, hedge funds and private equity – including leveraged buyout funds, venture capital funds and real estate funds – despite their pronounced differences, are often bundled together from an asset allocation perspective and referred to as "alternative investments".

A simplistic but, in our opinion flawed, approach is optimizing the traditional part or the private equity part of the portfolio and separately allocating a predetermined percentage to hedge funds. We argue that the different parts of the portfolio ought not be separately allocated and believe that the more appropriate approach is to have a unified asset allocation model that integrates forecasts and measures risk. In such situations, special adjustments have to be made to the private equity data. A well known problem with reported private equity returns is that the data is not mark-to-market. Further, accounting for reported returns is extremely heterogenous. If the error induced by these problems was common across all asset classes, the problem for allocation would not be very significant. However, when comparing these classes to other asset classes, this is not the case. Unfortunately, there has never been a solution to this problem, and in general, asset allocators have used the "bad" data in the reported returns in asset allocation models.



A better approach would be to correct the inaccuracies in the private equity and private real estate data. First, to estimate future returns, a factor model may be employed. Then, based on an analysis of historical spreads by vintage year, estimations for the expected return (mean) and a projected return distribution may be calculated. The process of arriving at estimations of returns, volatilities and correlations of the projected return distributions begins by constructing a historical data series. This data is then corrected, as explained above, to remove serial correlation induced by "stale" pricing. Finally, using a two-staged least squares approach, information is incorporated from public market analogs to each private equity class.

Examples of these analogs can be the S&P 500 for leveraged buyout funds, the NASDAQ for venture capital funds, and NAREIT's general REIT index for core real estate. In addition, one may also include other private equity classes in this estimate in order to incorporate a common, "private equity effect." From this model, a corrected return series as a base for calculating correlations and volatilities can be generated. Finally, in order to adjust for "overfitting" based on predicted values, one may explicitly estimate the degree of random error remaining, but excluded from the fitted data, to add appropriate noise into the fitted data series. Based on this corrected return series, more accurate estimations of the correlations and volatilities of the "true" return distribution are derived.

Notably, this process provides a clearer picture of the characteristics of the true distribution of returns over any given horizon which can then be compared to hedge funds. Without making this correction, true volatilities and correlations, over any holding period, will be inaccurate, resulting in over-weighting to private equity and private real estate.

MANAGER SELECTION

Within hedge funds there is little performance persistence at the strategy level over successive annual time periods. Nor do we find any material performance persistence of relative returns between strategies.

Figure 8: Annual Hedge Fund Strategy Performance Transition Matrix

Ex-ante Hedge Fund Strategy Transition Probability

- Low persistence in performance and low ex-ante predictability
- Tactical Asset Allocation and choice of strategy is important

	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Quartile 1	• 33%	• 20%	• 17%	• 30%
Quartile 2	• 23%	• 40%	• 27%	• 10%
Quartile 3	• 23%	• 17%	• 23%	• 37%
Quartile 4	• 20%	• 23%	• 33%	• 23%

Source: CCA, HFRI dataset for 12 strategies from 1998 to 2008.

The evidence of performance persistence within managers is mixed however. We find weak persistence of performance within the top hedge funds but little evidence of persistence among the bottom funds. Peer evaluation is often used to identify managers who are likely to have superior skills relative to their peer group. To the extent that there are common factors that affect all managers in a peer group, relative alphas (or value-add) can be estimated more precisely. Also, historical superior relative performance is a slightly better predictor of superior future absolute performance, compared to historical superior absolute performance.

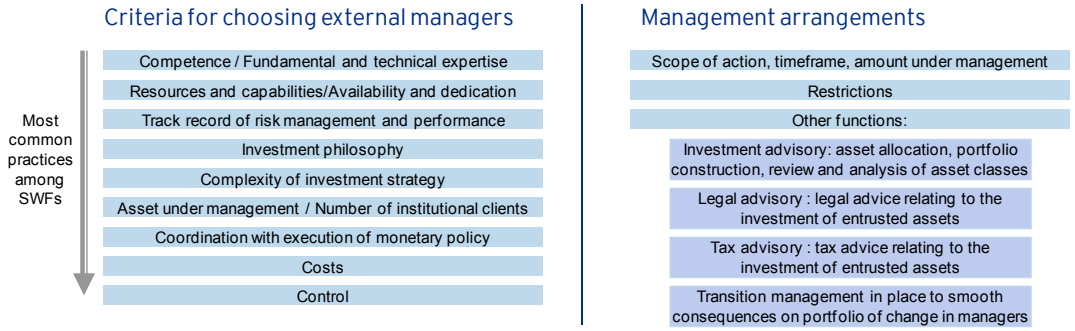
Because hedge funds invest in inefficient markets, they generate a significant part of performance from the special skills that talented managers bring; within the same strategy there can be a huge dispersion in performance between the best and worst performing managers. Thus, not only is it important to be invested in the right strategy, it is equally important to invest with the right manager. Manager selection involves implementing a disciplined process in both quantitative analysis and due diligence.

Adding value through active management is not easy however. It requires investors to find managers whose strategies are based on coherent investment insights,[47] to evaluate the risks of these strategies in relation to their rewards, and to negotiate fees that are reasonable in relation to the risks and the rewards. Active portfolio management rests on two principles. These being, identifying skilled managers and intelligently combining them into a portfolio, to diversify active risk. Manager selection is a research intensive process which includes; mapping the global hedge fund universe, then evaluating the investment approach, operational integrity and performance expectations of the most talented managers. Portfolio construction requires that selected managers, that have a sustainable competitive edge, be combined into portfolios using bottom-up, qualitative conviction in tandem with forward-looking modelling tools and previously defined portfolio weights and objectives. Risk control needs to be threaded throughout this entire process to maximize the predictability of results.

[47] Investment insights should embody an idea about the market mechanism that explains the origin and sustainability of excess return, and should be supported by systematic analysis of data. Salient examples in equity markets include value and momentum, the overpricing of high-beta stocks, and the overpricing of equity index volatility.

Process

Table 5: Manager Selection



Source: Citi

The process of selecting managers[48] involves reviewing manager credentials, evaluating fund strategies, examining track record and historical performance and assessing firm specific business risks and processes.

Sourcing. Managers may be sourced through referrals, capital introduction events and proprietary networks. There are also a number of manager databases which provide information on those hedge funds who choose to share their details with these databases.[49]

Screening and Shortlisting. This initial manager database may then be screened using a variety of criteria such as assets under management, length and quality of track record, product characteristics, peer group performance ranking as well as various statistical measures.These statistical measures may include breaking up sources of returns into alpha (skills) and beta (market exposure) components, risk adjusted performance ratios, drawdown[50] analysis, correlation with indices as well as upside / downside capture measures. This activity results in a shortlist of potential managers on whom due diligence is conducted.

Due Diligence. Hedge fund due diligence is the process of reviewing and monitoring the investments, the operations and management of managers. The objective of due diligence is to identify managers with whom to invest and to monitor them on an ongoing basis. Due diligence consists of an examination of the manager, personnel, investment strategies, business structure, operations, alignment of interests, conflicts of interest, valuation policies and procedures, risk management, compliance and investment terms. There are no hard and fast rules when it comes to due diligence – some funds devote a lot of time and make multiple on-site visits before making their initial investment, while others rely primarily on due diligence reports prepared by external consulting firms.

Investment Due Diligence. The investment due diligence process calls for deeper engagement with shortlisted managers. This stage may include conducting serious discussions to unearth the manager's investment thesis, evaluating portfolio performance, the research process, portfolio management and trading processes, internal incentive structures, track record verification and conducting reference checks. It usually reveals the way an investment manager budgets and controls for risk, implements positions, uses leverage or manages liquidity and takes other forms of trading risks. Takeaways from the investment due diligence process include an enhanced appreciation of:

- Quality and experience of the management team, including any key-person risks
- Investment strategy and associated investment research capability

[48] Criteria for choosing external managers usually includes assessing; (i) competence / fundamental and technical expertise (ii) resources and capabilities availability and dedication (iii) track record of risk management and performance (iv) investment philosophy (v) complexity of investment strategy (vi) assets under management and number of public sector / central banks clients (vii) costs (viii) control issues.

[49] Examples include EurekaHedge, AltVest, AsiaHedge, InvestHedge, Absolute Return, Lipper / TASS, HFR, CISDM.

[50] The largest losing period (the total drop point of maximum decline from peak to trough) during the investment period shown.

- Portfolio risks including leverage, concentration, counterparty selection and liquidity
- Risk management processes in place
- Process and organization of execution and trading departments
- Manager track record verification including corroboration with claimed strategy as well as benchmark and peer comparison
- Possible conflicts of interest

Operations Due Diligence. Operational risk is very broadly defined and includes risks associated with accounting, operations, compliance, audit, valuation, reporting and the oversight of personnel. This stage involves a review of the manager's front, middle and back-office operations and technology infrastructure. The operational due diligence process is not necessarily confined to just the manager but, may extend to conversations with external service providers including auditors, prime brokers, lawyers and custodians.

Portfolio Construction

Once managers have been selected, hedge fund portfolios can be constructed. An allocation and portfolio construction process would:

- Measure manager skill (alpha) and market exposures (beta) on a historical basis
- Potentially forecast alpha by combining historical data with a view of future. In other words, develop assumptions about the future performance of managers
- Incorporate degrees of confidence in the alpha and beta forecasts for each manager
- Specify, by way of constraints revealed, preferences for investment risk, return, and liquidity given current portfolio allocations, investment policy and risk tolerance
- Construct constraint optimized portfolios in an integrated fashion across managers and strategies

Table 6: Selecting and Combining Managers into Portfolios

Issue	Example	Approach
Definition of alpha	Manager with no skill leverages index 2x	Isolate skill-based returns
Data accuracy	Artificial smoothing of hedge fund returns	Correct returns for biases
Noisy returns	Luck interpreted as skill	Statistically eliminate Analyze outliers
Selection bias	Managers selected based on strong historical performance	Blend return history with other information
Uneven history	Managers with short track records	Blend return history with other information
Forecasting risk	Manager alphas tend toward mean	Estimate and incorporate forecast risk
Downside risk downside	Managers generate high returns but with event risk	Estimate and penalize risk
Lack of portfolio integration	Failure to recognize diversification	Integrate strategic allocation with manager selection

Source: CCA

Implementation Steps:

(i) Removing Source Biases in the Historical Return Series. As described earlier, removing serial correlation from historical returns data as well accounting for other data issues in manager returns, are the first steps in the asset allocation process.

(ii) Decomposing Historical Return into Active and Passive Components. Once data is "cleaned" each manager's return may be decomposed into active and passive components, by regressing each manager's return series against the relevant set of hedge fund indices or against tradable market factors. This analysis answers two questions for each manager:

- What are the manager's sensitivities to different market factors?
- How much skill does each manager have (measured by the information ratio)?[51]

(iii) Developing Forecasts for Each Manager Using Historical Data and Prior Beliefs about Active Performance. After decoupling manager returns into active and passive components, forecasts for the active portion of each manager's returns are developed. This is done by combining the historical data with prior beliefs for each manager, often expressed in terms of an information ratio.

(iv) Specifying a Relative Confidence in Active vs. Passive Risk. Even with a robust set of forecasts, an investor may still have less confidence in forecasts of active risk relative to passive risk. By expressing a relative confidence between active and passive risk, active managers may be explicitly penalized for lack of confidence.

(v) Running an Optimization Program and Identifying Candidate Portfolios. Once forecasts have been developed and specified to a relative confidence level, an efficient frontier of portfolios that shows the maximum return for each level of risk may be generated.

(vi) Evaluating Portfolios, Revisiting Assumptions and Constraints. After generating a set of optimal portfolios, investors may choose to revisit assumptions regarding (a) prior beliefs about manager information ratios, and (b) relative confidence in active versus passive risk. The optimization process may be re-run after this calibration phase.

[51] The information ratio is the ratio of expected residual return to residual risk.

Protecting Investor Interests

In the last few years, investor needs have evolved from a focus on just meeting performance targets (alpha) and gaining insights into investment issues from managers (non-investment alpha), to a much broader set of goals. A series of manager scandals, combined with increasing investor sophistication, has led investors to focus on the inherent misalignment of interests between investors and managers. This, in turn, has led to the demand for greater protection of investor interests.

Protecting Investor Interest: The Problem. In the long-term, manager and investor interests are aligned because manager success is largely a function of meeting investor needs. In the short-term, however, interests may not be perfectly aligned. For example, investors need their managers to deliver alpha and non-investment alpha while managers may ask their firms to deliver an ever increasing stream of profits. To meet investor needs, managers must continually reinvest in research and improve existing investment processes. To meet their own needs, on the other hand, managers must pursue expansionary policies such as growing assets in existing products, launching new products and / or developing new investors. When these paths are at odds, which is sometimes the case, managers of investment firms are faced with a dilemma: whose interests should they try to serve? They may ignore the long-term path to success and succumb to short-term considerations.

Protecting Investor Interest: The Solution. The solution is two-fold. First, managers may align their interests with those of their investors by setting up shared incentives and rewards. Second, where it is not possible to perfectly align incentives, managers may take specific steps to protect investor interests through sound business and investment practices.

Aligning Manager and Investor Interests. Shared incentives and rewards can be established through three broad measures:

(i) Corporate Structure. Funds that are controlled by management are more likely to look out for long-term investor interests for they have a greater incentive to look long-term and are more stable.

(ii) Firm Compensation. When properly structured, performance fees can be a very effective way to align interests.

(iii) Employee Compensation. Employee bonuses that are tied to investor performance ensure that staff understands the importance of alpha, and thus aligns the interests of employees and the firm with those of the investors.

Protecting Investor Interests. There are a variety of business and investment practices that serve to protect investor interests including:

(i) Growth. While growth can be an important signaling mechanism, it can also be disruptive. To protect investor interests, managers must manage their growth carefully.

(ii) Broker / Vendor Management. Broker / vendor management is an area of growing concern as it can introduce numerous conflicts. Eliminating soft dollar relationships is an important part of eliminating conflicts.

(iii) Standards of Employee Conduct. Setting standards of conduct for employees through a code of ethics is an effective way of protecting investor interests.

(iv) Investment Equality. Treating all investors fairly and equally at every step of the investment process is a sound investment practice, which serves to protect investor interests.

In summary, the requirements for success in investment management are changing. Not only do investors require alpha and non-investment alpha, but they also require that their managers take specific steps to protect their interests. These steps include aligning manager and investor interests through shared incentives and rewards such as management ownership and performance fees. In addition they involve protecting investor interests by capping product size, managing growth, maintaining investment equality and enforcing standards of conduct.

PERFORMANCE MANAGEMENT

Measuring Manager Performance. Accurate measurement of manager performance is critical. Investors cannot add alpha to a portfolio unless they can identify managers who generate alpha. However, analyzing manager performance and comparing performance across managers is often difficult because of differences in styles, asset classes, fund strategies and opacity in the returns generation process.

There are many different ways to measure manager performance. Managers may be evaluated on the basis of the total return that they generate, their returns relative to a benchmark, or by using risk adjusted return measures.

In order to compare managers, investors recognize that returns come from two major sources: skills based returns or "alpha" and exposure to fundamental factors or "beta". Since beta can be accessed in a low cost manner, managers ought to be compared on their ability to generate alpha. In order to do this, investors can strip out returns from fundamental market exposures and just measure their skill, based on which, managers may be compensated.

In the world of hedge fund investing, making decisions on the basis of historical data alone can lead to errors. For example, measuring historical alpha may not be enough since it is difficult to separate luck from skill. Then there are also related problems with selection bias, short track records and comparing managers with different length of track records. These issues reduce investors' confidence in a manager's ability to sustain historical performance. Investors can correct for these problems in two ways. First, they can add other sources of information (such as beliefs about steady state performance). Second, they can explicitly penalize managers for lack of confidence in estimates.

In summary, investors can measure managers based on skill, and adjust historical performance to reflect their beliefs and level of certainty.

Benchmarks and Performance Issues. Simply applying standard performance measures such as Sharpe ratios and excess return relative to a benchmark can often prove misleading. A better approach may take into account the unique set of objectives and concerns that central banks and SWFs face – internally created benchmarks can be effective in meeting safety and liquidity[52] requirements, measuring performance and increasing accountability. For instance, a new approach to reserve management may suggest that returns should be benchmarked with an eye to the same sort of variables that influence the judgment of the "right" level of reserves available at a certain point of time – in an extreme case, choosing a benchmark with potential capital outflows in mind.[53] Moreover, the need to be able to properly quantify risks, particularly "fat tails", that alternative investments contain, continues to present a special challenge to policymakers and asset allocators. The challenge of measuring performance is exacerbated when evaluating alternative investment managers, who have significant discretion and no natural benchmark.

Characteristics of a good benchmark

- Comprehensiveness: The benchmark should include opportunities realistically available, while measuring the performance of new investments and existing holdings
- Replicability: Total returns should be replicable (though not necessarily tradable)
- Stability: An index may change composition often, and these changes should be easily understood
- Expenses: In the normal course of investing, expenses related to withholding tax, safekeeping, and transactions are incurred. These expenses should be taken into account
- Simple and objective selection criteria: A clear set of rules should govern inclusion of asset and strategy subtypes

[52] SWFs are not particularly concerned with stock liquidity, which is a characteristic typically valued by short-term investors.

[53] The currency composition of reserves should broadly reflect the composition of potential capital outflows rather than trade flows.

Benchmarking Challenges

Many investors have turned to multi-factor models to measure hedge fund alphas. Unfortunately, traditional multi-factor models also fail to properly account for the specific characteristics of hedge funds given dynamic and nonlinear exposure to risk factors. Some attempts have also been made to capture hedge funds' nonlinear exposure to risk factors through the use of options. However, though theoretically robust, these models are characterized by high model risk and problems of misspecification. Hedge fund indices therefore appeared to be ideal candidates to serve as benchmarks. In this respect, the development of peer indices (i.e., non-investable indices) has been a response to the need of investors for a better understanding of hedge fund performance.

There are many popular benchmarks that track hedge fund performance. Firms that specialize in hedge funds have launched their own indices relying on proprietary databases. [54] In considering these benchmark performance metrics it is important to reiterate that:

- Hedge funds are not required to reveal their financial information, including their returns to data providers. The successful funds find it easy to attract capital and have no incentive to advertise their performance, while the least successful funds probably would not anyway reveal their information to a broad set of potential investors
- Hedge fund strategies produce returns that cannot be well explained by standard market factors, and also exhibit option-like features. The usual way to estimate the performance in such a case is to include options on factors, in addition to the factors themselves
- Hedge funds often hold illiquid securities in their portfolios. Usually, it is difficult to obtain current prices for such securities. In this case, managers use past prices to estimate the current value of assets. Therefore, we may, as we have seen earlier, observe serial correlation in returns. Annualized risk adjusted performance ratios can be significantly overstated if the serial correlation in returns is not taken into account
- Also, the history of hedge funds is relatively short. Even for more established funds, reliable data in most cases does not exceed 10 years. This creates a problem in analyzing risks across multiple economic cycles

Selecting managers or measuring performance on the basis of historical returns in either peer group comparisons, or with respect to a benchmark, is a complex evaluation of return, variance, correlation with the benchmark and time. Hence, simpler measures, while easy to calculate, may provide investors with incorrect recommendations.

Time. In order to meaningfully compare ratios and performance measures, one is required to use the same data period for all portfolios – the choice often becomes the lowest common data period. If one manager had six years of history and another had only two years of history, investors are forced to use the two-year history to compare the two managers. This reduction of data points for the manager with the longer history could potentially penalize managers with the more established record. Disregarding the additional data ignores the fact that the manager with a longer track record has delivered performance through different economic cycles. Bayesian techniques may be employed to incorporate a degree of confidence in histories to arrive at forward looking estimations.[55]

Luck vs. Skill. Outperforming a benchmark unfortunately does not tell the investor whether external or internal manager alpha is generated by skill-based processes.[56] Critical factors involved in

[54] HFR, CSFB / Tremont, MAR / Hedge, Eureka Hedge being some of the more popular ones. Existing hedge fund indices are not fully representative of the universe of hedge fund strategies. Many of them cover a relatively small fraction of the hedge fund population. We estimate that probably only a little more than half of existing hedge funds choose to self-report their performance to one of the major hedge fund databases. Most indexes are equally-weighted and based upon managers' self-proclaimed styles.

[55] There are many studies that help determine the minimum number of data points or time large enough for skill to emerge from noise. Two portfolios with identical variances, information ratios and tracking errors but differing only in length of history will have different confidence in skill – longer the history, greater the confidence.

[56] External Manager: Benefits may include professionalism – asset managers bring breadth of experience and efficiency; transfer of knowledge; outside credibility and transparency in benchmarking returns. However, they charge fees which detract from returns.

answering the luck versus skill question include time, desired degree of confidence, investment returns of the portfolio and benchmark, standard deviation of the portfolio with respect to the benchmark and the degree of correlation between the two.

Benchmark Volatility. The benchmark and the fund ought to have the same amount of risk to be compared in terms of risk adjusted performance. This is because investors care about the total amount of risk, and not just performance per unit of risk. To arrive at this, a hedge fund's performance may be leveraged or deleveraged using the risk free asset to make the risk in fund returns equal to that of the benchmark. This is also known as "the risk adjusted portfolio". Using this procedure, "leverage or deleverage" using the risk-free rate does not change the correlation characteristics[57]. This adjustment allows for a comparison of "apples to apples", namely, returns from the benchmark and the risk adjusted fund series now have the same volatility.

Correlations to Benchmark. When choosing between multiple funds, the funds, normalized for the benchmark volatility, could have different correlations with the benchmark and hence have different tracking errors. Tracking error is important to investors, because it provides a measure of the variability of a manager's returns around the benchmark. Investors would prefer, all else being equal, funds with lower tracking error. Assuming historical distributions are preserved in the future, the three-dimensional problem of a comparisons of return, risk and correlations has to be synthesized into a simple two-dimensional space of return and risk. The only portfolio with a zero tracking error is the benchmark portfolio as it is perfectly correlated with itself.

To create measures of correlation-adjusted performance, an investor may synthetically invest in the hedge fund, a riskless asset and the benchmark to ensure (a) the volatility of this composite is equal to that of the benchmark and (b) the tracking error of this composite is equal to the target tracking error. In other words investors have to consider basis points of risk adjusted performance, after ensuring that correlations of various funds versus the benchmark are also equal. Ideally, comparison between benchmark performance and fund performance should:

- Express risk adjusted performance in basis points
- Provide clear advice on portfolio construction – specifically between the mix of risk-free asset, the benchmark (passive investing, assuming the benchmark is investible) and the active portfolio (active management)
- Provide rankings that are identical with rankings based on skill for equal histories
- Keep a constant annualized tracking error target over all time horizons
- Account for different funds having different time periods of historical performance data by rationalizing for confidence

SWF Benchmarks

Funds that have a higher reliance on portfolio investment and use of external managers tend to release more benchmarking data. The funds of Norway, Singapore, Korea and Kazakhstan, amongst others, disclose some of their benchmarks for traditional assets but very few SWFs do so for alternative assets. Kuwait's SWF is one of the few funds that discloses alternative investment benchmarks. For private equity, it expects to earn 500bps greater than the rolling 10-year average of the S&P1200. For its hedge fund portfolio, it expects to return 100bps above the HFRI Fund of Funds Index. For its real estate holdings, it specifies earning 125 bps above the UBS Global Real Estate Index.[58]

Internal Manager: Benefits include centralized control of assets, ensuring effective coordination across managers and portfolios; In-house expertise can allow additional portfolios to be managed internally and can provide financial market expertise to other government entities, including the Central Bank, Ministry of Finance, etc.

[57] Modigliani F., Modigliani L., *Risk-Adjusted Performance*, Journal of Portfolio Management, vol. 23, 1997.

[58] http://www.kia.gov.kw/En/Alternative_Investment/Objectives/Pages/default.aspx accessed on Nov 3, 2009.

CONVERGENCE: THE MULTI-ASSET MANAGEMENT FIRM

How may SWFs think about multi-asset vs. multi-strategy firms?

There has been renewed investor interest in the past year on "convergence", referring to the crossing over of hedge funds into private equity[59] space and vice versa. These are seen as integrated strategies that make tactical investments in private equity and hedge funds across global markets, with the ability to utilize leverage and go long or short in any opportunity. Often, these are treated as absolute return strategies managed with the objective of market neutrality and low beta versus any single asset class. This section examines the advantages and disadvantages of this form of investing.

"Convergence" may be seen in a much broader fashion as something to describe the breakdown of the lines dividing fund managers in all asset classes and all types of investment management. "Convergence" means the path that a firm embarks upon to become a comprehensive multi-asset manager. A multi-asset manager invests its capital in the full panoply of assets that exist today: public securities, private securities, commodities, real estate and other hard assets, loans, leases, insurance and other types of contingent claims and intellectual property. A multi-asset manager is, therefore, to be distinguished from a multi-strategy hedge fund, which predominantly invests in public securities. The multi-asset manager owns, borrows**,** lends, leases, insures or reinsures on behalf of its fund investors, not just securities, but businesses, commodities, real estate, and other physical assets, such as energy plants, tankers and equipment, and intangible assets, such as patents, royalties and other rights.

To each category of asset, the multi-asset manager may apply a broad range of strategies, so a multi-asset manager can be both multi-asset and multi-strategy in nature. The multi-asset manager may operate some funds that are market-neutral and others that are directional. Ultimately, multi-asset managers may operate funds known as multi-asset funds that permit dynamic investment and re-investment in all assets classes. These multi-asset funds will be structures with their own unique set of terms and characteristics, just as today, hedge funds, private equity funds and real estate funds are recognized categories, each possessing a fairly standardized set of characteristics.

Traditionally, each of the asset classes mentioned above were the province of a different manager at a distinct shop. A firm either ran a hedge fund that held predominantly public securities, a private equity fund that acquired control or strategic positions in businesses, a commodity pool that traded commodities futures, or a real estate fund that invested in real property. Few managers invested in more than one of these asset classes. There were, and continue to be, many obstacles impeding multi-asset management in the same fund, including regulation, tax and filing requirements, liquidity preferences of investors, the varying time horizons[60] associated with different asset classes, and investors' desires for manager specialization and control of asset allocation.

The movement to multi-asset management may be the next dominant trend.

The Advantages of Multi-Asset Management

From an investment and organizational perspective, benefits flow from the ability of a fund to invest across asset classes, as opposed to just in the securities markets. These advantages are, for the most part, the same factors that have given the edge to the multi-strategy manager over the single-

[59] SWFs are increasingly involved in acquisitions and strategic transactions. Though many funds prefer to invest in debt or non-controlling equity positions, a small but growing number of funds are seeking substantial minority or even controlling equity stakes. Since some SWFs are at the early stages of entering into the buyout market, they do not yet possess the full suite of management capabilities that the leading private equity firms have. Thus, they are more likely to work with existing management teams and are perhaps less prone to seek management changes if return expectations are being met. This is also reflected in purchases of second-stage buyouts after a private equity firm has completed the initial restructuring required. However, as the SWFs continue to build out their direct investment capabilities, their investment preferences may also evolve to more closely resemble that of traditional private equity funds.

[60] Many SWFs have a much longer time frame for managing investments than the typical private equity firm. Unlike financial sponsors, these SWFs do not have a need to exit an investment through an IPO or sale and can take an ownership position for longer than five to seven years.

strategy firm.[61] However, these benefits increase in the context of multi-asset management due to the greater universe they impact.

Much Larger Opportunity Set to Select Investments. One of the most powerful and obvious advantages a multi-asset fund possesses is the ability to select investments from a significantly larger canvas of opportunity. Just as the multi-strategy hedge fund may have an edge over the single-strategy manager in finding attractive investments due to the latter's confinement to one domain, even when opportunity is very thin in that sector, the multi-asset fund has a substantial edge over single asset funds.

Horizontal Breadth. There are going to be times when a particular asset class is significantly cheaper than other asset classes, and other times when it is more expensive. A multi-asset fund has the ability to play when the asset class is compelling and the option to step away when it is expensive. The single asset fund, by definition, does not have the option to dynamically move between asset classes. The traditional hedge fund can only play in the public securities market, the real estate fund has only real estate from which to choose, the private equity player may only be able to invest in private businesses, and so on. Even during times when rough equilibrium exists between asset classes, the wider array of opportunity favors the multi-asset fund. With more flexibility in choice, the multi-asset fund can better direct the fund to the upper tier of quality in any one asset class than can a fund of equal size focused exclusively on that one class, forcing the latter to reach lower in quality due to its narrower mandate.

Of course, can one fund master all asset classes equally well? If not, the logic breaks down, because the advantages of multi-asset management may be undermined by shoddy investment selection and oversight, as the fund invests in areas beyond its real expertise or spreads itself too thin. This issue will again be addressed later.

Time Horizon. When acquiring and managing assets such as real estate and businesses, the time horizon of the investment is frequently longer than that appropriate for the typical hedge fund. Monthly, quarterly or annual liquidity schemes generally do not fit with such assets. The typical real estate or private equity fund has lockups ranging from seven to 10 years in duration. A multi-asset fund will require a longer hold on capital as well. This longer time horizon dramatically expands the range of investments that a manager can consider. Some types of investments do not make sense as one time bets, but are very compelling from a probabilistic standpoint, when made as a series of investments over time. Any one investment may go bad, but statistically the odds are better of investing serially and letting the probabilities play out. Hedge funds will often invest in a tier of relatively illiquid opportunities, relying on the more liquid portion of the book to handle redemptions. These funds assume their redemptions will never reach a level such that they will have to exit the illiquid investments prematurely. Prudence alone dictates that only a limited portion of the portfolio can be dedicated to highly illiquid assets. A multi-asset fund will not be under that constraint, at least to the same degree.

Short-term performance demands are also a significant constraint on a hedge fund's ability to invest in long-term investments. Real estate and private equity investments seldom generate near-term profits due to significant up-front transaction and infrastructure costs, and the bulk of the profits being realized at the end of the investments' lives. A hedge fund manager may risk underperforming his or her peers in the short-term by investing in such long-dated products. As a consequence, the manger could face investor redemptions before the long-term benefits can be realized. The longer term lockup of a multi-asset fund solves this problem.

Real estate and private equity funds may have the opposite bias. Even though their charters may not restrict them from investing in public securities or short-term investments, their fund structures may inhibit them from making such investments. The terms of those funds typically provide for a return of capital to the investors once an investment is sold. The managers may be reticent to make short-dated investments even if the rates of return will be high because these managers generally lack a reinvestment option. Faced with the choice of making short-term investments and sending back the capital after a year or two, or making a long-term investment that will more closely match the seven to 10 year life of the fund, the funds will likely concentrate on the longer dated

[61] In contrast to single-strategy managers, Funds of hedge funds (FoHF) are a popular way for predominantly retail investors to invest in hedge funds. FoHFs provide quick exposure and diversification by investing in multiple managers and different investment styles. They do asset allocation, due diligence, manager selection, funds administration and monitoring on behalf of investors. They, being commingled vehicles, require lower initial investments than investing directly in hedge funds. Sometimes, given their long-standing relationships, they provide investors with access to managers otherwise closed to new clients. Since they charge a fee in addition to manager fees, returns for FoHFs in general are lower than for investing directly in hedge funds.

investments. A properly structured multi-asset fund eliminates this disincentive by having reinvestment rights corresponding to its dynamic, asset allocation focus.

Marking the Portfolio. In addition to illiquidity, unless a hedge fund has a side-pocket, the difficulty of valuing longer term assets, their hockey stick nature of returns (no change in value and then a sudden major revaluation), and the dilutive or windfall impacts of investors moving in or out of the fund, make a hedge fund an unsuitable vehicle for such investments.

Diversification Benefits: Lower Risk and Volatility. A multi-asset fund that can invest in comparable return opportunities across an array of asset classes should over the long-term produce superior returns with less risk and lower volatility compared to those funds investing in just one asset class. The positive and negative forces impacting sentiments of public security holders should have differing impacts on real estate, commodities, loans, intellectual property and privately held businesses. The differing peaks and valleys of these different asset classes should help smooth the performance of the overall portfolio. Coupled with the belief described in the preceding subsection that the wider array of investments should lead to better returns than a single asset fund, a multi-asset approach provides a powerful combination of superior expected returns and lower risk over time.

Synergistic Investment Effects of a Multi-Asset Approach. A multi-asset approach can have a positive impact on returns over and above the wider array of investment opportunities it brings. Many synergies flow from having in-house expertise covering all asset classes. In other words, a multi-asset fund may produce higher returns than just summing the returns of separate funds covering those same asset classes. A multi-asset fund that has repetitively worked within each asset class with trusted, experienced, in-house or external talent may provide synergies in the evaluation and selection of investment opportunities, as well in the implementation and execution of these strategies.

Multi-Dimensional Opportunities. Investment opportunities do not always fall neatly within one asset class. Some of the most undervalued situations arise because an amalgam of assets are involved, covering a variety of categories, requiring valuation techniques from many different disciplines. For example, the real estate manager may not be aware of a tempting property that is available in a bankrupt estate. Even when such awareness exists, that investor may be intimidated by the uncertainties, gamesmanship and time required to acquire a property. Conversely, a hedge fund may be ill-suited to recognize the value of undeveloped or environmentally contaminated real property in a bankrupt estate without the knowhow of an experienced real estate developer to gauge the cost, timing and probability of success of entitling the land, cleaning it up, constructing the desired improvements and then successfully marketing it to the end user. Much the same can be said of underperforming businesses residing in bankruptcy. Weather derivatives, energy and reinsurance are other examples of managers in different asset classes that can mutually benefit one another.

A multi-asset fund also provides the investment manager the platform to apply talent built in the public markets to private assets, skills that the typical private equity or real estate specialist does not possess. Hedging, trading and risk management expertise can benefit private assets, not just public ones. In sum, a fund possessing expert and reliable talent in all asset classes can bring together the multi-disciplinary talent pool necessary to evaluate, enter, see through to fruition and then exit in an optimal manner any investment, regardless of the complexity of the situation.

Ability to Move Quickly. Having in-house expertise for all assets classes positions the multi-asset fund to move more quickly than others in pursuing an opportunity, an edge that can be critical when short deadlines are imposed. Given the amount of liquidity in the marketplace, seizing and creating attractive opportunities is paramount to generating returns. Such a fund already has the expertise to assess any asset for sale instead of having to locate, interview and retain special consultants for the initial analysis.

Economies of Scale. The more capital an investment firm can manage without degrading the attractiveness of the assets it acquires, the greater the benefits the firm can bring to its investors. In other words, there are many economies of scale operative in investment management. The more capital a firm has to invest, the larger the commissions and fees such investing generates for dealers, bankers and finders. This increases the likelihood of receiving that all important first-call when an asset becomes available for sale. The greater the amount of money and stock the firm borrows, the lower the borrowing costs it pays and the higher the short rebates it receives. Large, successful and growing firms also have an edge in attracting the best talent. A multi-asset fund, because it deals in so many asset classes, may have superior ability to scale without undermining performance and, therefore, the ability to garner these advantages for its investors

Organizational Benefits Accruing from a Multi-Asset Fund. As described above, a multi-asset approach enables a multi-asset fund to make better investment decisions. But it may also generate organizational efficiencies for the investment management firm which, in turn, ultimately inures to the benefit of the investors. Human capital is the most precious capital an investment management firm possesses. Retaining superior talent is the greatest challenge for today's hedge funds with so many investors vying to back the next rising star. The greater the responsibility and intellectual challenges the fund complex can offer that talent, the happier the talent is likely to be. New areas to apply investment skills and new funds to run and grow are "good things" in investment talent's minds.

A multi-asset approach facilitates these occurrences. The multi-asset approach also enables a multi-asset fund to create more diversified revenue streams. This is particularly important when the fund complex depends principally upon performance fees to compensate employees. The greater the number of asset classes covered by a multi-asset fund, the greater the likelihood at any point in time that at least some of those areas will be generating positive performance. This better enables the investment firm to continue compensating associates in sectors, strategies and asset classes temporarily suffering from a dearth of attractive product, or, conversely, with compelling out-of-favor opportunities arising from poor near-term performance of the asset class. Supporting such units during those challenging periods is more feasible when other parts of the multi-asset complex are profitable.

The Side-Pocket as a Vehicle

Many hedge funds are venturing into asset classes other than public securities because they recognize that superior risk adjusted opportunities can often be found in those domains, relative to those extant in the liquid markets. Why else sacrifice the greater liquidity of the public markets?

As described above, once a hedge fund ventures outside public securities, other asset classes present barriers to investment. One obstacle is that the expected holding period usually extends well beyond the redemption term of a liquid hedge fund. Valuation presents another challenge. Hedge funds must price regularly and accurately, an unrealistic standard for assets such as real property, businesses, and physical assets, such as power plants. The time and expense involved in obtaining professional appraisals or valuations would make doing so prohibitive. Cash realization may be the only proof that the fund has bought an asset at a significant discount to the true market price, accomplished a change of use or otherwise added significant value to the asset, or built a new business that others will purchase at a multiple in the future. A third problem is that disposition may occur years from the time the investment is first made. During that period when value is being added, but the extent to which can be difficult or impossible to quantify, the investment may be marked at cost, while at the same time investors will be entering or exiting the fund. This means a long-term investor's share of that value is being diluted and new investors are gaining a windfall.

The solution to this problem for many hedge funds is the side-pocket. When investments of the sort described in the preceding paragraph are made, they are placed in the side-pocket and only those investors in the fund at the time that have elected to participate in side-pocket positions make the investment. Subsequent investors entering the main fund do not participate in that investment, even if they have approved side-pocket investing. When the original side-pocket investment is sold, the proceeds go only to the side-pocket investors who originally funded the investment. Essentially, a structure has been created akin to a mini private equity or real estate fund for the side-pocket investments. In other words, the side-pocket is a mechanism for introducing multi-asset investing to hedge fund investors to the extent they elect to participate in the side-pocket. A side-pocket moves a hedge fund only part way to the vision and benefits of a multi-asset fund, in which capital is dynamically allocated among the best opportunities in all asset classes.

The Barriers to Multi-Asset Management

If such strong benefits flow from multi-asset management, why are not all funds multi-asset funds? Despite the inherent advantages, there are many obstacles to becoming such a fund, as more fully described below.

Tax, Filing and Regulatory Impediments. Tax and filing requirements associated with real estate, loans, physical assets and sometimes private equity are significant barriers to hedge funds participating in these asset classes, at least as such funds are typically structured today. The

common hedge fund is, therefore, precluded from adopting a true multi-asset approach. The manager must create a special fund and seek out investors with special characteristics. Regulatory considerations may also serve as an inhibitor to a full-fledged multi-asset approach to investing.

Time Horizon and Liquidity Barriers. As previously discussed, a significant mismatch exists between the monthly, quarterly or annual liquidity of the typical hedge fund, and the much longer time frame required for a real estate investment, an originated loan with a five to seven year maturity, a royalty stream or an acquisition of a private business to bear fruit. Liquidity is an essential characteristic of any security. Investors that hold assets with greater illiquidity expect to receive a higher expected return. Liquidity is also a systematic risk factor. The significant finders, investment banking, consulting and legal fees, and the major investment in entitlement or turnaround work, required by these transactions, necessitate long periods to recoup the up-front costs and produce superior investment results. Consequently, real estate and private equity funds commonly have seven to 10 year lockup provisions.

Most hedge funds are not positioned to make investments with such long-term time horizons due to the possibility of intervening investor redemptions. The drag on near term investment performance from the heavy up-front expenditures in both capital and time is a further deterrent to investing in illiquid asset classes. For traditional private equity and real estate funds with capital locked up for seven to 10 years, the premature return of that capital upon realization of a short-term profit discourages them from making shorter term trades or investments in the public markets.

Investor Preference for Manager Specialization. Investor preference for manager specialization is another potential obstacle to funds adopting the multi-asset path. Many investors adhere to the logic that it is much easier for a manager to do one thing well than to do many things. When investors observe a fund beginning to invest in many different strategies and asset classes, they can become fearful that the fund is diluting its expertise by investing in less productive areas. Even worse, investors might be concerned that the fund is spreading itself too thin as it expands into new areas and risks undermining the very core of the firm's existence. These concerns can of course be alleviated by bringing in first-in-class expertise with long track records and substantiated know how and managing that talent with hedging, financing, risk management and analytical skills.

Investor Preference for Controlling Asset Allocation and Manager Selection. Some investors feel that a multi-strategy fund interferes with their ability to control the allocation of capital across strategies and the selection of individual managers. Because a multi-strategy fund dynamically reallocates capital among strategies, an investor in such a fund could never be certain of how much of the investor's portfolio is committed to any particular strategy. Moreover, an investor might be happy to have the fund manage money with respect to one strategy, but might feel other managers are better suited to handle other strategies. A multi-strategy fund presumably eliminates the investor's ability to ensure that his or her capital is invested with who the investor presumes to be the top manager in each particular strategy.

Investor discomfort with a multi-asset approach may even be greater than the original opposition to multi-strategy investing. A multi-asset fund affects the investor's control over asset allocation, not just the allocation of strategies within a particular asset class. The investor's assets may be deployed with the investor having no control over the current asset allocation and how it might shift over time. And just as with the securities markets, there are many different strategies that can be utilized with the other asset classes. Take for example real estate. The portfolios could be run in a directional or more of a hedged fashion. Different sectors might be targeted. A fund could invest in raw land, apartments, homes, retail or industrial properties. A fund might limit its geographic focus. A fund could engage in development or purchase only cash flowing properties. Private equity investing, lending and commodities trading can be similarly differentiated.

The Marketing Challenge. A multi-asset approach requires tapping into investors that are prepared to lockup capital for periods as long as 10 years. This requires a very different mind set than that of the hedge fund investor who has the intangible comfort of being able to retrieve capital on a quarterly or annual basis. A strong track record and success in raising considerable capital in the hedge fund context is no guarantee of success in the multi-asset world.

In summary, adding multi-asset capabilities sometimes significantly enhances a hedge fund's ability to generate attractive risk adjusted returns in its existing flagship fund(s). Multi-asset management is the approach many top-notch investment firms will eventually adopt due to the superior characteristics of that investment style for long-term investing. A possible way forward to this mode of investment is through a side-pocket as well as new funds that will provide purer plays on other asset classes.

CONCLUSION

SWFs are commonly established out of balance of payments surpluses, official foreign currency operations, the proceeds of privatizations, fiscal surpluses, and / or receipts resulting from commodity exports. Governments previously deposited money in global banks and low risk fixed-income securities that provided very low returns. The low returns on these investments have prompted nations with surplus foreign reserves to invest in alternative assets to achieve higher returns.

The rise in the popularity of hedge funds is leading SWF investors to consider this asset class as an integral component of their portfolios. Within hedge fund investing there are issues related to asset allocation, portfolio construction, data, manager selection, risk management, performance measurement and management. These issues need to be carefully considered and this paper outlined important considerations which may help investors arrive at better approaches in allocating to hedge funds.

In many instances the distinctions between hedge fund and private equity investments are less pronounced. Many hedge funds have invested in relatively illiquid securities and some private equity firms have made private investments in public equities. This new hybrid model of investing is still evolving and will give birth to new organizational forms, notably the multi-asset management firm. The paper explored this concept and highlighted the pros and cons of investing in such entities.

Citi Capital Advisors is an alternative asset management platform that offers a broad range of targeted strategies and products to select institutional and ultra-high-net-worth (UHNW) investors. Our structure brings together the combined benefits of proven investment managers, an innovative operational and risk management infrastructure and the vast resources of Citi's global network.

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