APPLYING A RISK BUDGETING APPROACH TO ACTIVE PORTFOLIO CONSTRUCTION

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Risk keeps investors up at night. While the definition of risk can take many forms, from the volatility of returns to the potential for permanent loss of capital, the simplest concept of risk is the uncertainty of the future value of an asset. Investors take risk across asset classes, or beta exposures, with the expectation that a risky asset will provide a long-term return higher than cash. Additionally, investors take risk with active strategies, or alpha exposures, given a belief that each active strategy will outperform a given benchmark over time.

While active managers often bundle alpha and beta together in their attempt to outperform a benchmark, beta and alpha are two very different types of risk exposures. Beta is mostly passive exposure to asset classes, with the investor seeking to capture a risk premium for holding a particular asset class and absorbing price volatility and other risks such as illiquidity or permanent impairment of capital. While not a fully inclusive measurement of risk, the return volatility of each asset class can be used as a starting point for measuring beta risk.

Conversely, alpha is the result of departures from benchmarks based on the insight and skill of an investment management team or model to exploit inefficiencies in the market pricing of securities with the goal of outperforming that stated benchmark. Alpha risks include the strategy underperforming its benchmark, drifting from the strategy's objective, or business issues within an investment management firm that can distract a portfolio management team from effectively executing its strategy. Many of these risks are challenging to quantify and must be addressed through a comprehensive manager due diligence and selection process. We can quantify alpha investment risk as the annualized volatility of alpha returns (net of beta returns) or tracking error.

Beta and alpha exposures are both important aspects in helping an investment program achieve its return objectives. As such, appropriate levels of risk should be targeted to each type of exposure based on the unique considerations and goals of each investment program.

A risk budgeting approach to asset allocation is a key underpinning of NEPC's investment philosophy. Forecasts of volatility and correlations between asset classes are used to compute total portfolio volatility. That statistic can then be deconstructed to determine the allocation of volatility to each asset class. For a traditional portfolio allocation of 50% equities or more, close to 90% of portfolio volatility is driven by equities. Sources of risk, such as a significant concentration in equity risk, are often hidden when viewing diversification solely through asset class capital allocations. This process generally drives investors to construct more efficient, risk-aware investment programs.

We believe that investors have an opportunity to use a similar risk budgeting framework to analyze the composition of risk among active strategies, separate from beta exposure. By integrating the sizing of alpha risk into a total portfolio risk budgeting framework, investors can better understand the role of each exposure in their portfolio.

This process will help investors target the appropriate aggregate allocation to active risk and the

appropriate balance of risk among active strategies. By embracing *Active Risk Budgeting* in the portfolio construction process of selecting and sizing active investment strategies, we believe more efficient active portfolios can be constructed, complementing a strategic asset allocation to deliver more consistent returns in meeting the objectives of an investment program.

A Decision Framework for Active Portfolio Construction

To build a program of active strategies, an investor must make a variety of decisions, including:

- Determining the level of active risk

- Choosing where to allocate active risk

- Selecting and sizing active risk exposures
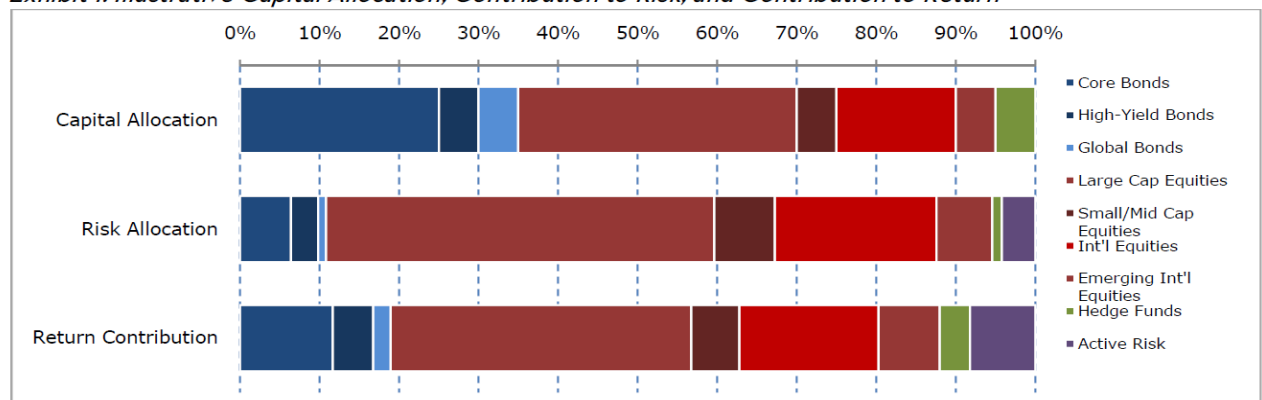
The Level of Active Risk

The risk tolerance for alpha volatility may be high (low) for investors with belief (skepticism) in active management as a source of added value to total portfolio returns. While these philosophical considerations can shape decisions, the active risk tolerance may instead be driven by structural conditions to earn a certain level of return to meet portfolio objectives. In these cases, expected alpha can help to satisfy a total return requirement not easily achieved through strictly passive market exposures.

The level of total portfolio active risk is often analyzed in terms of tracking error (the volatility of returns due to departures from the strategic benchmark). A more instructive approach to understanding how active strategies contribute to portfolio risk is to integrate active risk into the total portfolio risk budgeting analysis. This approach reveals how much of total portfolio volatility is driven by beta (passive market exposure) and how much is driven by alpha (active manager skill). Generally, this analysis will confirm the work of academic studies and empirical evidence that have shown the majority of returns can be explained by an investment program's asset allocation. This framework allows the investor to incorporate active portfolio decisions with consideration of the overall risk tolerance of the investment program.

In Exhibit 1, we consider a traditional asset allocation of 60% global equities, 35% fixed income, and 5% hedge funds.[1] The first row of Exhibit 1 illustrates this portfolio's asset allocation, diversified within each broad category. The second row converts the asset allocation into risk allocations to each asset class and active management in aggregate. Not surprisingly, the asset allocation, or exposure to betas, dominates the portfolio risk budget, taking up over 95% of total portfolio volatility, while alpha contributes less than 5%.

The third row details the contribution to return. This analysis reveals that the expected aggregate

Exhibit 1: Illustrative Capital Allocation, Contribution to Risk, and Contribution to Return

Source: NEPC

Applying a Risk Budgeting Approach to Active Portfolio Construction

contribution to return from alpha is almost double the risk allocation of active strategies. Return impact can be compared to risk allocations (row 2) and capital allocations (row 1) to consider whether there is a commensurate expected return for the amount of risk taken and the amount of capital deployed – a useful way of understanding how much an investor expects to be compensated for holding each of these risks. Alpha can be a very efficient source of return, with a relatively minor impact on total portfolio risk, but a meaningful impact on total portfolio returns if high value-add managers are selected and sized appropriately.

Where to Allocate Active Risk

Most investors have limited time and resources available to undertake the important, but complex, process of performing due diligence and hiring active managers. As a result, most investors should consider using the precious time available for manager research to pursue high-conviction active strategies in areas of the capital markets expected to be less efficient and more likely to present opportunities for active strategies to deliver alpha.

As a result, most investors should allocate most of the portfolio's active risk budget to less efficient asset classes or to less constrained strategies such as hedge funds or global asset allocation. Instead of allocating equal time to researching and monitoring active managers throughout the entire portfolio, the investor may choose to gain cheap, passive exposure to larger, more efficient asset classes where the opportunity for alpha is more limited. For more insight into a qualitative framework relying less on historical data analysis and instead on identification of managers likely to add value in less efficient asset classes, please see our white paper Revisiting the Active vs. Passive Decision - Moving Beyond the Data-Driven Framework (available at *www.nepc.com*).

In conjunction with determining where to pursue active risk and to what degree, investors must consider whether to employ style-specific strategies (value vs. growth and capitalization specific) or more unconstrained strategies (all cap, global, or multi-asset class managers), and how many strategies to implement within an asset class.

These decisions should be framed around the objective of acquiring the desired exposure to a strategic asset allocation while identifying high-conviction, active strategies capable of delivering alpha over the long-term.

A comprehensive research process focused on identifying a strategy's investment thesis is critical. The process of articulating a strategy's investment thesis serves to distinguish the competitive advantages supporting a strategy's ability to deliver long-term sustainable alpha. A quantitative risk budgeting framework should support, but not replace, these important due diligence steps in building active management programs.

Selecting and Sizing of Active Risk Exposures

Historically, investors have used a narrow, focused approach to active manager selection, choosing one or more active managers for each asset class. We find that the "style-box" execution of manager selection can lead to sub-optimal portfolio structures. Through this framework, the allocation of total active risk in a portfolio is often simply a residual outcome of selecting the best manager for each asset class. This approach takes minimal consideration of the active risk contribution from each strategy, or investigation of what is truly alpha (independent, uncorrelated insights) versus excess risk through higher beta, or how various strategies in the program complement one another.

Both qualitative and quantitative analysis can be utilized to better understand the efficiency of an active portfolio. Qualitative considerations include gaining comfort that the portfolio of active strategies has balance across styles of active management such as bottom-up, quality, stock selection strategies, diversified quantitative strategies, top-down macro-economic theme focused strategies, or aggressive strategies identifying high growth companies. Exposure to each type of strategy should be analyzed in terms of active risk contribution, and not simply capital allocations.

Active Risk Budgeting can be used to better understand the contribution to total active risk from each alpha source in the portfolio. The sizing of active risk exposures should align with the level of conviction in each active strategy. This tool can

confirm that the largest active risk sources are strategies with the most efficient and highest conviction alpha expectations. It can also be used to test alternative active risk allocations for improvements in the efficiency (return per unit of risk) in the active part of the portfolio and, consequently, the overall portfolio.

Active Risk Budgeting

NEPC's proprietary Active Risk Budgeting tool is developed from the same framework as asset allocation risk budgeting. At the asset class level, we determine contribution to risk by taking the weight of each asset class in a portfolio and forecasting asset class volatility and correlations between asset classes. In Active Risk Budgeting, we use quantitative tools to forecast the volatility and correlations of active returns after adjusting for rolling beta exposures in a portfolio. Rather than use a static measurement of beta exposure for a strategy over its full history, we use a rolling two-year window of beta exposures to reflect the dynamic nature of most active strategies' exposure to broad market risk. These inputs can be used to produce several types of diagnostics such as rolling beta exposure of each strategy, alpha per unit of tracking error (information ratio), and alpha correlation matrices that can inform decisions to improve portfolio efficiency.[2]

We first strip away each active strategy's market exposure, or beta. The beta for each strategy is defined as the benchmark exposure that the strategy is attempting to outperform. For uncon-

strained strategies targeting outperformance above cash, such as hedge funds, we choose an appropriate market benchmark as the beta, such as the S&P 500 for equity-biased strategies.

Each strategy's beta-adjusted historical alpha is then used to understand the volatility and correlation of alphas among strategies. These results can be used to inform forward-looking expectations of these two required inputs – forecasts of alpha volatility and correlations between various alphas. The framework is flexible and allows for adjusting results for statistical significance or any qualitative insights into the future volatility of an alpha stream or expected relationship with another strategy's alpha. Importantly, our Active Risk Budgeting framework does not use forecasts of alphas as an input. Manager alpha can be very unstable over time as a strategy's particular style moves in and out of favor. Tracking error and correlations between alphas, although variable based on market regimes, are more reliable over time.

Using the portfolio highlighted in Exhibit 1, with a 60% equity, 35% fixed income, and 5% hedge fund allocation, we assume that this asset allocation is implemented across 12 active managers with different alpha volatilities and correlations between alphas, and illustrate the results of this analysis in Exhibit 2.

In this example, despite targeting balanced capital exposures to each active strategy, active risk analysis reveals strikingly different risk allocations. Most notably, a 10% capital allocation to a high

Exhibit 2 – Illustration of Active Risk Budgeting
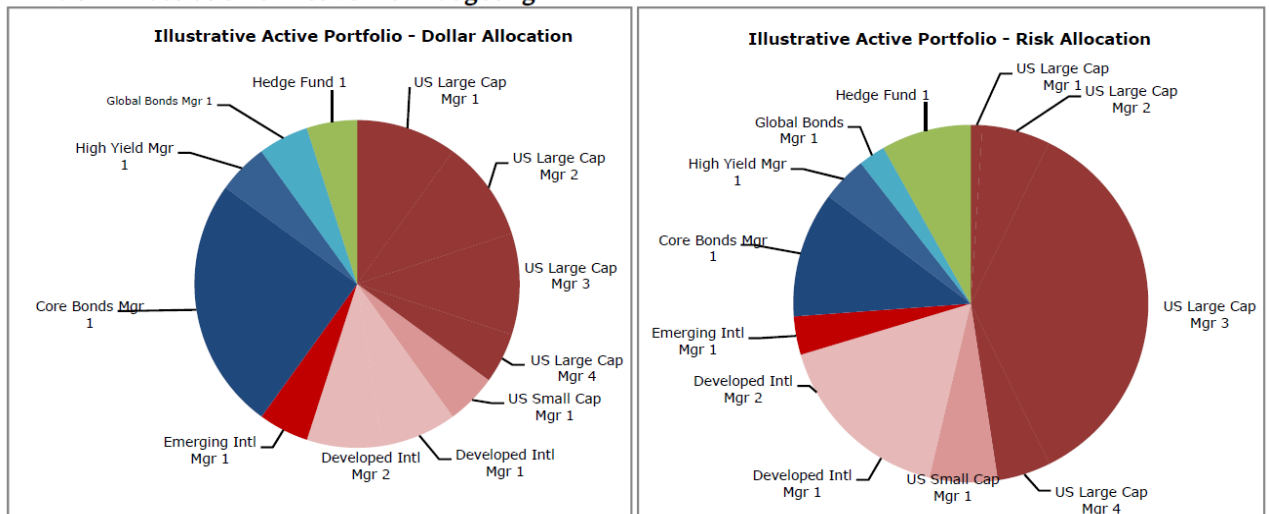
Source: NEPC

[2] Please see the appendix for examples of additional analytics available from the Active Risk Budgeting tool.

tracking error strategy in a very efficient asset class (US Large Cap Manager 3) consumes 35% of the total portfolio active risk, squeezing the alpha risk contribution from strategies in less efficient asset classes like emerging markets or high yield bonds. Secondly, while inefficiencies exist throughout capital markets and the capital structure of the global economy, this program targets almost three-quarters of total alpha volatility from equities.

Larger active risk contributions from certain active strategies may be appropriate if these managers are expected to deliver high levels of alpha, especially if the opportunity set is expected to be robust in a less efficient asset class. Often, however, this analysis can result in a need to reconsider capital allocations across a lineup of active strategies, potentially resizing (while maintaining the desired asset allocation) if conviction in certain strategies is not as high as conviction in other strategies in the portfolio.

In general, balanced active risk contributions from many uncorrelated, high-conviction managers will lead to more efficient information ratios for an investment program, meaning higher expected active return at lower levels of active risk in the total portfolio. NEPC's Active Risk Budgeting tool can be used to develop a more efficient portfolio structure by optimizing the alphas within the constraints of the strategic asset allocation targets or by analyzing different combinations of managers.

Conclusion

Portfolio construction and active management around a strategic asset allocation can be sources of added value for investors. While asset allocation decisions will have the largest impact on returns, we believe that the combination of identifying high conviction active strategies and using a risk budgeting framework to allocate active volatility weights will lead to a more efficient portfolio construction process, improving the probability of achieving program objectives. By evaluating the current investment program using an active risk budgeting approach, investors will achieve better insight into future active performance of a portfolio.

The additional return from active strategies can be vital in meeting program return objectives or protecting capital in down markets. At NEPC, we use Active Risk Budgeting as an integrated component of our investment process. Risk-aware asset allocation and comprehensive manager research are the foundation for developing solutions for client portfolios. Active Risk Budgeting is used as a critical tool in appropriately sizing active exposures in the total portfolio and allocating risk efficiently across active strategies. Active Risk Budgeting can help investors develop an improved understanding of sources of active risk and contributions to risk from both beta and alpha exposures. Through this process, we seek to help clients build more efficient total portfolios capable of meeting and exceeding program objectives.

## Appendix A – The Higher Potential Diversification of Alpha vs. Beta

Alpha should be uncorrelated with both market exposures and other alphas in a portfolio. Modern portfolio theory tells us that uncorrelated assets will diversify better (produce a less volatile portfolio) than highly correlated assets. A lower correlation between two assets will result in a lower standard deviation, or return volatility, for the combined portfolio of two assets. If we consider each alpha and each beta as individual assets, we see a clear difference between the diversification potential of each type of exposure.

Exhibits A1 and A2 highlight the potential diversification in beta and alpha portfolios based on the illustrative portfolio used earlier. In Exhibit A1, the risk composition of a portfolio of betas is first considered if we assume that all asset classes are perfectly correlated. When we introduce the benefits of diversification through less than perfect correlations in the second column, we see a meaningful 25% reduction in portfolio volatility.

When we perform a similar exercise for a portfolio of active managers in Exhibit A2, considering only the alpha (subtracting all beta exposure), we see even more profound diversification benefits, as diversification reduces active risk by 60%. Combining many uncorrelated alphas together can be very powerful in producing excess returns at reasonable levels of tracking error, leading to high portfolio information ratios (active return per unit of active risk).

Exhibit A1: Benefits of Diversification in Beta Portfolio
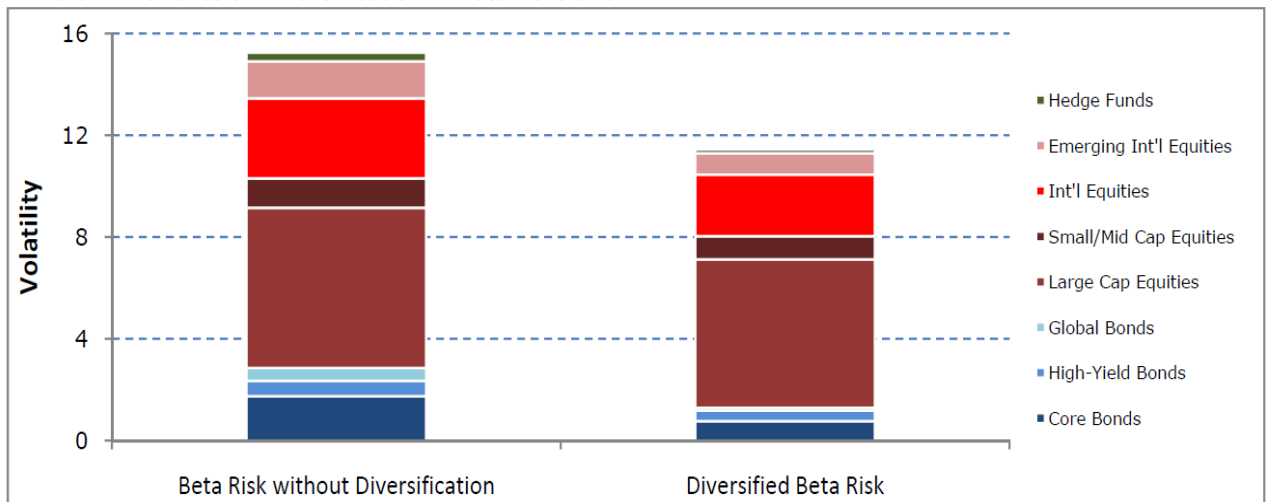
Source: NEPC

Exhibit A2: Benefits of Diversification in Alpha Portfolio
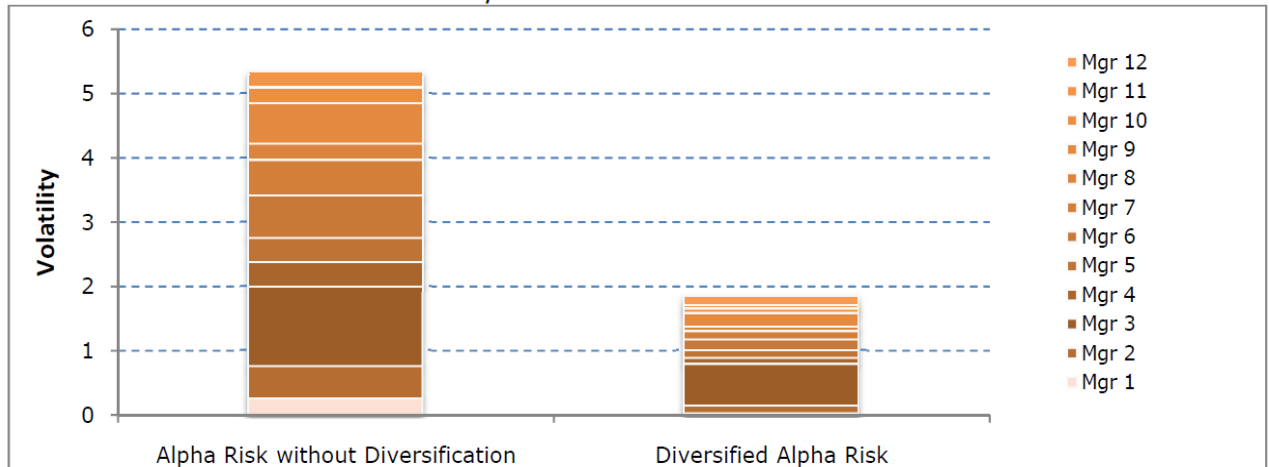
Source: NEPC

Appendix B – Additional Analytical Output Produced Through Active Risk Budgeting

In addition to application at the portfolio level, Active Risk Budgeting can also be used within an asset class (focusing only on domestic equities, etc.) or hedge fund allocation. The approach can often reveal insights into the relationships between various managers (through correlation analysis) or the level of beta exposure provided by a particular strategy.

Opportunities for consolidation or better complementary relationships can be identified through alpha correlation analysis. In Exhibit A3, an illustration of alpha correlations for a composite of active equity strategies, Equity Manager 4 has relatively high alpha correlations to several other active strategies. While this isolated measure should not be used as the singular reason to consolidate or replace an active strategy, this insight can prompt further research and analysis to confirm a strategy's role in the portfolio.

As part of isolating the alpha of a strategy, market exposure - represented by the appropriate index

for each active strategy - is stripped away to focus the analysis only on the manager's excess return. By adjusting the market exposure of a strategy over time based on rolling regressions of market exposure, the Active Risk Budgeting framework produces a more dynamic analysis of a strategy's alpha over time. While not a key output of alpha analysis, the historical rolling beta of strategy can be an additional output worth analyzing.

Analysis of beta exposure can be especially interesting when analyzing a program of hedge fund strategies. By removing residual market exposure, we are left with something closer to a pure alpha stream and can analyze whether the hedge fund has truly delivered alpha or simply taken on broad market risk. Exhibit A4 illustrates the average, minimum, and maximum beta exposure to the S&P 500 over each strategy's full return history. While investors tend to focus on total returns of hedge fund strategies, this analysis indicates that while some hedge fund strategies have very low and stable market beta exposures, others have return streams that owe a significant portion of their returns to beta exposure.

Exhibit A3: Alpha Correlations of Several Equity Strategies

	Equity Mgr 1	Equity Mgr 2	Equity Mgr 3	Equity Mgr 4	Equity Mgr 5
Equity Mgr 1	1.00	0.00	**0.34**	0.24	**0.45**
Equity Mgr 2	0.00	1.00	0.00	**0.40**	**-0.29**
Equity Mgr 3	**0.34**	0.00	1.00	**0.70**	0.22
Equity Mgr 4	0.24	**0.40**	**0.70**	1.00	**0.63**
Equity Mgr 5	**0.45**	**-0.29**	0.22	**0.63**	1.00

Highly Negative (<-0.25)	Relatively Uncorrelated (-0.25 – 0.25)	Moderately Positive (0.25 – 0.50)	Highly Positive (>0.50)

Source: NEPC

Exhibit A4: Beta Exposure of Representative Hedge Fund Strategies

Source: NEPC